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NEW YORK, THURSDAY, MAY 25, 1911.

CONTENTS.

Editorials 1253
Final N. E. L. A. Program 1258
A. I. E. E. Election and Annual Meeting 1259
Electric Vehicle Club Meeting 1261
Kentucky Electric Company's New Station at Louisville 1262
Underground Electrolysis in New Orleans 1262
Manufacturers and Patent Situation 1262
Chicago Subway Situation 1263
Electric Motor Discussed at Joint Meeting of Engineers at Boston 1263
The Easter Sessions of the Société Francaise de Physique 1264
Commission News 1265
American Electrical Engineers.—XXXIV. M. W. Buchanan 1268
Current News and Notes 1269
Electricity in New York City 1271
New York Edison Company 1280
Underground Conduit Construction. By Edwin R. Quinby 1293
New York City by Night 1298
Brooklyn Edison Company 1305
Retailing Niagara Energy 1321
Concrete Tungsten Lamp-Post 1326
Experience with Concrete Poles at Oklahoma City 1327
Some Notes on the Limitations and Advantages of Hydroelectric Power. By Clarence P. Fowler 1328
Commercial Education of Central-Station Solicitors 1332
Motor-Installation Record Card 1333
The Computation of Electric-Plant Insurance 1335
Effective Central-Station Publicity. By D. H. Howard 1335
Modern Electric Laundries 1336
Part Played by Electricity in Building Sky-Scrapers 1337
Recent Developments in Train Lighting 1339
Simple Method for Calculating Illumination. By J. R. Cravath ... 1340
LETTERS TO THE EDITOR:
Transformer-Principle Electric Heating Apparatus. By Gustav W. Meyer 1341
The Tungsten vs. Flaming-Arc Lamp. By J. Gustaf V. Lang 1341
Digest of Current Electrical Literature 1342
Book Reviews 1346
New Apparatus and Appliances 1347
Industrial and Commercial News 1356
General News 1361
Weekly Record of Electrical Patents 1368

THE CONVENTION CITY.

As the metropolitan capital of the Western Hemisphere, and a city familiar more or less to all Americans, it is needless here to refer to the civic institutions and boundless activities of New York. Looking only at its electrical side, in no other city is public-utility service quite so closely related and quite so necessary to the daily life of the community. Service here means service, and is paramount to all other considerations. Millions are invested in reserve apparatus so that the people may have light and transportation no matter what else may betide. To be sure, in a community numbering over 4,750,000 of human beings, such precautions are necessary; but while the unthinking public appreciates in the main the quality of the service rendered, it has no comprehension of its cost and the eternal vigilance necessary to its accomplishment. Members in attendance on the convention next week of the National Electric Light Association will have unusual opportunities of becoming acquainted with the big side of the central-station industry. Here are grouped the largest steam-driven power stations of the world, magnificent in their layout yet withal conservative in engineering practice. The city is pre-eminently the electrical center of the world, the equipment of whose power houses exceeds by approximately 100 per cent that of the monumental generating stations erected on the American and Canadian sides of Niagara, the next largest center of electric development. The finest and largest steam engines and steam turbines ever built may be seen in New York. The city is smokeless and for the most part poleless. Electric light, railway, telephone and telegraph wires are chiefly underground.

Examples of the most expensive and most enduring construction in power houses, substations, distribution systems, underground, surface and elevated railways, gas holders, etc., are everywhere to be seen. Hundreds of millions of dollars have been expended by the great trunk lines entering Manhattan Borough in electrifying that end of their roads and in erecting monumental terminals. New York has not only to contend with the most complex problem in transportation, but it is also the scene of greatest activity in electric traction construction in the world. The subway system operates daily with ten-car express trains every minute and three-quarters and manages to care for over 1,000,000 passengers daily. Some comprehension of the traffic conditions may be had from the fact that the various city railways carry in round numbers 1,500,000,000 yearly. Incidentally the chief railway generating station possesses the greatest number and the largest exhaust steam turbines ever built and operates at an average economy unequaled by any other large system in the country. Electric light men will find much to interest them in the electric signs, street lighting, lamp posts and the systems of the local lighting companies, particularly in that of the New York Edison Company, which controls about four-fifths of the electric lighting business of the city, a considerably larger proportion than the Consolidated Gas system possesses of the total gas business.

As to the convention arrangements themselves, much that is commendatory may be said. Never in the history of the association have the sessions been held in such ideal quarters, for the Engineering Societies Building is the finest structure of its kind in the world. All the plans that forethought and experience could suggest have been made to avoid confusion and chaos, and indications point to the most successfully conducted convention ever held by the national body. The hotel arrangements have been carefully made and reservations secured in the finest hostelries in the country, all of which are moreover within a few minutes' walk of the convention quarters. Entertainment features have been provided in abundance so as to hold the delegates intact, and in a city like New York this is a wise provision. The convention program itself leaves nothing to be desired. It consists chiefly of committee reports embodying definite suggestions. If conscientious work has been done a new record should result; for in an organization the size of the National Electric Light Association much of the matter to be presented must of necessity be predigested by committees or the convention will become unwieldy. It is predicted that the attendance will be the largest ever recorded and we trust the interest will be commensurate with the size of the gathering.

WHY NOT NATIONAL ELECTRIC ASSOCIATION?

When the National Electric Light Association was established in 1885 the name adopted was a very apt and expressive one. The great possibilities of electric lighting were dimly realized and an enthusiastic band of electrical business men in Chicago, mainly representatives of manufacturers and supply dealers, issued a call for the first meeting in the year mentioned. But in a very few years the association passed into the control of the operating electric central-station companies of the country, and for the last twenty years it has been the great representative of the commercial electricity-supply industry of the United States. It has grown from a membership of seventy-one to more than 100 times that number, and its beneficial influence on the industry it serves has been almost incalculable.

With the development of the art and the expansion of the central-station service, the member companies of the association have come to distribute electricity that is used to supply not only light but also heat and to operate motors for all kinds of machinery. What the association stands for now, and has for a number of years stood for, is electric service. Indeed, the expression "electric-service company" seems to be gradually supplanting "central-station company" as more accurate, since telephone, gas and private water-works companies also provide utilities from central stations. The useful term "electricity-supply company," employed in Great Britain, appears never to have obtained a foothold in this country in popular speech, although it describes precisely the function of the electric central-station company.

In view of the fact that the name "National Electric Light Association" is now inadequate to outline the functions of the association, has not the time arrived to consider its modification to insure comprehensive accuracy? "National Electric Service Association" would be truthful and expressive, but perhaps it would be still better simply to drop the word "light," making the name of the organization "National Electric Association." Would this not be a change for the better as indicating the wide scope of the society? One practical advantage would be that the name would be shortened 25 per cent, and all who are engaged in society organization work or in technical journalism will testify that this is a real advantage. It may be objected that the present name is of historical significance, or possibly there may be some legal objection to the change of name. But it would seem, nevertheless, that the change is desirable, and therefore we venture to offer the suggestion for the consideration of the association. It will be remembered that with the development in electric railroading the old American Street Railway Association altered its name first to American Street and Interurban Railway Association and recently to American Electric Railway Association. So that there is precedent for the so-called National Electric Light Association to change its name to signalize the progressive broadening of its field.

THE MODERN ELECTRIC CLUB.

One of the pleasing indications of the constant vitality of the electrical industry and the wide-awake interest of those engaged in it is the number of electric clubs—often luncheon clubs—in different cities of the Union, but particularly in the West. Such clubs exist in Cleveland, Chicago, St. Louis, Denver, Minneapolis, Omaha, Los Angeles and other cities. They do a great deal of good in making electrical men acquainted with one another and inculcating a fraternal spirit of harmony, and at the same time it is the usual practice to present papers and addresses, not always of a technical or even of an electrical nature, but giving the members something new to think about. Meetings are held weekly or monthly, and it is found that these gatherings arouse a spirit of enthusiasm among men engaged in the various branches of the industry that would be difficult to bring about in any other way.

In Chicago the Electric Club, now three years old, has demonstrated its usefulness and popularity, and may be cited as an example. Here the membership is limited to 500, and the present number of members is 330. This number was considerably larger a year ago, but the present list represents only men who actually take an interest in the club and who pay their dues. Members who fail to pay their dues are dropped from the roll after a reasonable lapse of time, so that the present membership is an actual and not a fictitious list. The club has over $3,000 in its treasury, and may some time procure permanent quarters, although the prevailing feeling is to move slowly in this matter and not to put up too much sail, so that the organization will not be driven on the rocks, as was the case with a former and more pretentious Chicago Electric Club some years ago. The present arrangement is to hold the weekly luncheons in a room set aside for the club at a restaurant.

A feature of the work of the Chicago club has been the providing of speakers at the weekly luncheons. This has proved a drawing card, as the names of the speakers and their subjects are announced in the notices of the meetings mailed to members in advance. During the club year ended Jan. 31, 1911, forty-seven meetings were held, there being no meetings during the month of August. At thirty-eight of these meetings speakers were provided, the other meetings being principally social

meetings in charge of the entertainment committee. The average attendance at meetings where speakers were announced was fifty-one and at the purely social meetings forty-five, showing that the privilege of hearing the speakers was appreciated. Several speakers of prominence were secured, including Dr. C. P. Steinmetz, Mr. Bion J. Arnold, Mr. R. R. McCormick, president of the Chicago Sanitary District; Dr. R. A. Millikan, professor of physics in the University of Chicago, and others.

The talks given were not all of an electrical nature, about one-third being on non-electrical subjects. The subjects discussed show a wide range; some of the addresses were scientific or technical, some practical or commercial, and some in lighter vein. Nine of the speakers were connected with public-service enterprises, either municipally or privately operated; six were electrical engineers, five were electrical business men, five were lawyers, and the remainder were scattered among a number of occupations. The club affords a place where electrical men of all shades of opinion may gather, and, therefore, is considered a free and open parliament for speakers of varying views, provided the organization is not used for mere personal advertisement. Electric clubs of this character have proved their value in Chicago and elsewhere, and no doubt the example is one that might be followed to advantage in other cities where electric clubs do not exist at the present time.

THE LUMINOUS EFFICIENCY OF INCANDESCENT LAMPS.

In the Digest of contemporaneous electrotechnical literature reference has been made to an article by Dr. Leimbach, in the *Elektrotechnische Zeitschrift*, on the radiation properties of incandescent lamps. Certain definitions are presented in the article that call for notice before the conclusions can be clearly apprehended. The relative radiating power is defined as the ratio of the radiated power to the absorbed power of a lamp, the light-effect is defined as the ratio of the luminous radiation to the total radiation, and the net efficiency or useful effect is taken as the ratio of the luminous power to the power absorbed. Only four types of lamps are compared, namely, the carbon-filament, Nernst, tantalum and osram lamps. The highest relative radiating power (75.6 per cent) is given to osram, which means that three-quarters of the power absorbed at the lamp terminals is converted into radiation presumably reaching the external surface of the lamp, and one-quarter is lost within the lamp non-radiatively—that is, by conductive and corrective heat. The light effect is also highest in the osram lamp (4.6 per cent), which means that over 95 per cent of the power radiated from the lamp is non-luminous. Consequently the efficiency, or useful effect, of the osram lamp is the highest among those compared, or 3.5 per cent, which means that about one-thirtieth of the power consumed at the lamp terminals is translated into light, the remainder being converted into heat not capable of affecting the eye. Although the luminous efficiency of the best available incandescent lamps is shown to be miserably small, yet this conviction carries with it the comfort that there is much room for improvement. Just as we are led to believe that virtue is self-rewarding but humdrum, and heaven is driven to find its joy in the repentant sinner, so a world of unity-efficiency lamps would be well lit but gloomy, while low-efficiency lamps light up the hearth of hope.

DUPLICATION COST DUE TO COMPETITION OF PUBLIC-SERVICE COMPANIES.

Public-service corporations are willing generally to accept the principle of regulation provided they are protected from competition. It is obviously unjust for a state or municipality to regulate the rates of a public-service utility and at the same time permit the further regulation due to competition. This condition of double regulation exists to some extent in the telephone situation in Chicago. There the principal telephone company is obliged to make rates fixed by a city ordinance and at the same time it faces the prospect of competition from a competitor long dormant, but which is now making active preparations for effective telephone service. Bearing on this situation an interesting resolution was introduced recently in the City Council of Chicago by the chairman of the committee on gas, oil and electric light, which has in charge the revision of telephone rates. This resolution touches a situation that has an interest extending beyond the confines of Chicago, and which relates to all public-service enterprises where competition exists or may exist.

In the preamble of the resolution it is set forth that public-service corporations are natural monopolies, and, when subject to reasonable regulation, can best fulfil their functions when unhampered by competition. History shows, it is said, that such competition must necessarily be of brief duration, ending with the absorption of one company by another. The resolution goes on to show in its preamble that the consolidations mentioned result in the purchase of much duplicate property for which actual expenditure has been made, as well as franchises and rights representing no actual expenditure. It is therefore declared to be the sense of the City Council of the City of Chicago that in all consolidations and combinations of public-service corporations in that city the construction account of the purchasing company shall be charged only with the cost of the property actually used by, and useful to, the purchasing company in the furnishing of the service involved. In any future negotiations looking to the determination of reasonable rates for such service the valuation to serve as the basis for such rate determination shall embrace only such property as has been constructed at the actual cost price and which is not an unnecessary duplication of the property of the purchasing utility, including an allowance for engineering, supervision, interest, taxes and insurance during construction, plus 8 per cent since the date of construction, less the profits which have been taken out of the property, which are not to exceed 8 per cent.

Apparently the Aldermen of Chicago were uncertain whether this resolution should be adopted, and it was accordingly referred back to the committee where it originated. The purpose of the resolution is undoubtedly to protect the public against rates for public service made too high by unnecessary duplication of physical property, and, more than that, by including the valuation of franchises and licenses representing no actual expenditure. Of course, a still better way to meet this situation is not to permit competition to get a foothold where the existing utility is subjected to governmental regulation. In the particular local case to which the Chicago Alderman's resolution applies the competing company had a franchise granted it a number of years ago, before the present-day ideas of periodical revision of rates had obtained acceptance.

Exactly what the effect would be of the acceptance by the Chicago authorities of the principle laid down in the resolution it is difficult to predict. Perhaps the competing utility would have little incentive to sell out if no allowance were made to it for the value of its franchise. The equities of the situation are somewhat complicated; but, at any rate, it is significant to observe that municipal authorities are giving their attention to the anomalous situation presented where there is at once regulation by the authority of the state or municipality and by the force of competition.

A STUDY IN CONSERVATION.

There has been much discussion regarding the effect of deforestation on the flow of streams and upon rainfall, but the definite information on the subject has been very small in amount. Now and then some particular case, like the Paris floods of last year, has been traced with considerable certainty to conditions resulting from the gradual deforestation of the watershed. Data in the United States have been particularly unsatisfactory, even to an extent that has permitted those who are pecuniarily interested in the rapid destruction of forests to challenge the production of definite information. In point of fact the exact analysis of the various causes leading to abnormally high and abnormally low flow of streams requires an accumulation of facts over so long a period that the forest destroyers would have ample opportunity to clean up the rest of the available woodland long before certainty in the matter could be reached. However, Circular No. 176 of the United States Department of Agriculture gives a sufficient amount of information concerning a number of American rivers to make it clear that deforestation is at least highly dangerous to stream flow and probably productive of somewhat disastrous results Both the Geological Survey and the Forest Service have been studying the subject, and, as the circular sets forth, "the results warrant the statement that, unmistakably, floods are steadily on the increase on some of our most important rivers. Particularly is this true of the rivers which rise in the Eastern mountains. The increases seem to be greater on those watersheds where the condition of the surface has been the most changed." This is quite what was to be expected from the general principles involved.

The real conditions are somewhat masked by the irregular variations in rainfall. It has sometimes been claimed that rainfall itself is affected by deforestation, but of this there appears to be no sufficient meteorological evidence, at least as regards ordinary conditions. In a large way it still may be possible that the distribution of rainfall, if not its absolute amount, may be affected by the change of surface conditions produced by deforestation. It would be interesting, for example, to know what would be the probable effect of stripping the northern part of the coast range along the California coast and leaving it as bare as is the southern extension of that range. The facts set forth in the circular before us, however, deal only with the frequency of extreme conditions, either of flood or low water, and where these are obtained by comparison of two successive decades the latter one covers a period in which deforestation has been particularly active. Taking ten important rivers rising in the Appalachian system, it was found that eight out of the ten showed very material increase in the floods during the latter half of the period investigated as compared with the earlier half. In most of these instances the periods of low water had increased as well, which is a natural result of the same conditions as those that would produce increase of flood.

To take one typical example, the Potomac was investigated by means of records covering the period from 1890 to 1907 inclusive. During the first half of this period there were nineteen floods and fifty-four periods of low water. During the second half there were twenty-six floods and seventy-six periods of low water. The same sort of data were found in most of the other streams investigated. This is enough to justify at least the gravest suspicions regarding the effect of the steady deforestation that has been going on. When one comes to analyze the actual effect of deforestation it becomes evident that the most serious result, although fairly chargeable to the fact, is indirect; that is, the destruction of the forest sponge by fire following cutting off of the trees. As everyone knows from experience, vast quantities of saplings are left wherever lumbering goes on, ready to start tremendous fires on small provocation. Once an area is thus burned over its value as an element in the watershed is very greatly diminished, and when several times burned over, as is frequently the case, the results are even more serious. When this burning occurs in a mountainous region and is accompanied by denudation, as often happens, the damage is permanent, and even where there is no denudation it takes a long period of years to remedy the conditions produced. An interesting sidelight is thrown on the subject by a study of rare cases in which floods have decreased within periods similar to those already considered. In at least one of these cases the effect is traced with a high degree of probability to the breaking up of the hard surface of the prairie and its replacement by well-tilled farming land. Farming land appears to be next to forest the best conservator of rainfall, much inferior to forest it is true, but vastly better than barren rock and hard native sod.

The problem of conservation as regards stream flow is chiefly that of protecting the watershed against destruction of the forest sponge. The chief damage is done not so much by the destruction of the larger trees as by the incidental exposure to fires which destroy everything, even going down to the rock and leaving the ground ready for gradual but complete denudation. In a study of the Potomac River made by the Geological Survey it has been shown that more than one-quarter of the effective upper drainage area of the river has already been practically destroyed by fires following extensive cutting. The change produced by this destruction is computed by the Geological Survey to amount in any period of vigorous rainfall to a reduction of natural storage capacity amounting to 6,000,000,000 cu. ft., so that during even a few days of rain this huge extra amount would run off to produce flood instead of being held back to come into the stream gradually after the rain ceased. The effect of this damaging condition is felt over and over again throughout the year. The importance, therefore, of close control of the wooded watersheds of the country stands out clearly enough.

Reasonable supervision of the conditions of cutting, such as is easily exercised when the areas are under government

control, is capable of doing much good in the way of preserving the flow of the streams. It is a mistake to suppose that permanent preservation of a given forest growth is the object of such conservation. This would unquestionably hold conditions stable, but they can be held under good control merely by proper regulation—that is, by intelligent forestry directed, first, toward the prevention of the permanent damage that comes from denudation and, second, to such regulation of cutting as shall prevent the destruction of the forest shelter either directly by indiscriminate stripping of the land or indirectly by the fires which always follow reckless lumbering. Bearing in mind the evidence presented in the circular referred to, the bill passed at the last session of Congress for the preservation of the Appalachian watershed is a subject for national congratulation. It comes too late to preserve much that can now never be recovered. It is in time, we hope, to prevent further serious damage. The hydraulic resources of the country are so steadily rising in importance that their preservation is a matter not of sentiment but of general concern.

A NEW FORM OF ARC LAMP.

In a paper abstracted in the Digest three French investigators, MM. Urbain, Scal and Feige, describe a new form of arc lamp which possesses some curious and perhaps valuable properties. The object of the investigation was specially directed toward the production of an arc extremely rich in ultra-violet rays, but incidentally the result was an arc not only rich in the ultra-violet but more than usually efficient as an illuminant. A great deal of nonsense has been talked about the ultra-violet rays, chiefly, we are afraid, by people with strange kinds of protective spectacles to sell. It is undoubtedly true that reckless exposure to ultra-violet rays is inadvisable, like reckless exposure to extremely intense radiation of any kind. In particular, the ultra-violet rays may give one a disagreeable case of sunburn and affect the eyes superficially, with the production of disagreeable symptoms akin to sunburn. Arc lamps, including the carbon arc, the magnetite and the titanium arcs and the quartz-mercury arc, are well-known sources of ultra-violet rays, and occasional cases of trouble to the eyes from these sources appear. It should be mentioned, however, that such accidents seem to be strictly avoidable in the sense that they have occurred only to those who have been exceedingly careless and exposed themselves at short range to the powerful radiations to an extent that would be unwise if they gave off no ultra-violet radiation at all. In other words, the reasonable precautions which one ought to take in dealing with very powerful light sources as such are practically effective against the ultra-violet portion of the radiation of some sources. The only exception to this rule, perhaps, is the Finsen arc between iron terminals, which is relatively weaker in the luminous radiations than the others, but very strong in the ultra-violet. This arc, from which very serious accidents have been reported, is, however, not used for lighting purposes as such, and hence is unlikely to produce any injuries that can properly be classified as accidental.

It was toward the production of an arc of this class, specialized as it were for ultra-violet radiation, that the French investigators bent their efforts. The value of the ultra-violet rays for bactericidal purposes, as in the sterilization of water and various other substances, the bleaching of oil and for electrotherapeutic purposes, is well known. The present investigators endeavored to secure high efficiency in the ultra-violet by driving the temperature of the electric arc to the highest possible point while using electrodes rich in ultra-violet rays. In this way they would be able to furnish in the extreme ultra-violet not only the rays proper to the vapor of the electrodes, but also a large amount of ultra-violet from the electrodes considered merely as hot bodies. Tungsten, the most infusible metal known, seemed to give the best chance for obtaining the properties sought in the arc. They found, however, that it was practically out of the question to form a stable arc between tungsten terminals in an inert gas. Though even a trace of oxygen permitted them to work the arc, the oxides given off then were deposited on the walls of the globe to an extent that defeated further progress. The investigators went on to try various metals as cathodes while preserving the tungsten anode as a source of light, and finally settled upon mercury as the most available cathode. This enabled them to work with a rather short arc either in a vacuum or in an inert gas, the mercury vapor serving the purpose of giving the necessary stability to the arc.

In the ordinary mercury lamp with an iron anode the radiation is derived purely from the mercury vapor, but in the lamp here described the important factor is the anode of highly refractory metal driven to an enormous temperature, the mercury vapor playing an altogether secondary rôle. The authors state that the passage of metallic particles from the positive electrode to the negative is not sensible, so that the arc is relatively permanent in spite of the enormous temperature. It hardly seems possible that this effect would not make itself felt after protracted use, but it appears at least that the conditions of stability are good. The result of this arrangement is that the light produced is due chiefly to the incandescence of the tungsten anode, upon the continuous spectrum of which are superimposed the radiations of the mercury vapor. The color of the light is bluish-white owing to the very high temperature of the anode, and its specific consumption is stated to be only 0.45 watt per candle. This figure is entirely in harmony with the principles of action set forth, corresponding to very high incandescence of the anode. This arc operates on a difference of potential as low as 12 volts, a property which renders it convenient for some conditions of use. It is also, as was intended, rich in the ultra-violet, so that it is applicable to the purposes for which it was originally devised. For ordinary use as an illuminant such an arc, although at times convenient in laboratory use, would seem to possess no great importance, its efficiency going lower than that of the flame-arc, the quartz-mercury arc or even the intensive forms of magnetite arc. As a source of ultra-violet rays its relative efficiency as compared with other sources is not stated, although it is very likely to be good. It is, however, of a great deal of theoretical interest and should prove very useful to the investigator owing to its great power and efficiency, its ability to furnish what is for most purposes a point source, and the fact that it can operate at so low a voltage as to be easily run from a few cells of storage battery.

Invitation to Attendants at N. E. L. A. Convention.

The *Electrical World* extends a cordial invitation to all those attending the convention of the National Electric Light Association to visit its offices at 239 West Thirty-ninth Street, three blocks west of the Engineering Societies Building, the convention headquarters. The *Electrical World's* suite, No. 170, at the Hotel Astor is also at the disposal of its friends during the week, and those who so desire may have their mail directed there with the assurance that it will be held for them or subject to their instructions.

Final N. E. L. A. Program.

Several changes and additions have been made to the program of the National Electric Light Association convention since May 4, when the full program as then arranged appeared on page 1072 of our issue for that date. Two additional sessions and several new papers and reports appear on the final program.

CALENDAR.

On Monday, May 29, the registration office in the Engineering Societies Building, 29 West Thirty-ninth Street, New York, will be opened at 11 o'clock. In the evening will be held the official reception to President and Mrs. Freeman and a dance at the Hotel Astor beginning at 8:30 o'clock.

On Tuesday morning at 10 o'clock will be held the first general session. In the afternoon at 2:30 o'clock there will be three "parallel" sessions, the second general, the first technical and the first accounting.

On Wednesday at 10 a. m. will be held the first commercial session, to be followed by an executive session at 12:30; the second accounting session and the second technical session. There will be no afternoon session on Wednesday. At 8:30 a public-policy meeting will be held in the New York Theater.

On Thursday morning the first transmission, second commercial and third accounting sessions will be held. At 2:30 p. m. the third technical and third commercial sessions will be held.

On Friday at 10 o'clock the second transmission and fourth commercial sessions will be held. The third general session, which will be the final official event of the convention, will be held at 2:30 p. m. on Friday.

ADDITIONS.

Among the new items on the calendar are the executive and public-policy sessions on Wednesday. At the executive session proposed constitutional amendments will be presented by Mr. Frank W. Frueauff. Mr. Arthur Williams will discuss the work of the public-policy committee; Mr. George H. Harries will present the report of the treasurer and the nominating committee will be selected. The public-policy session will be opened with the presentation of the report of the public-policy committee by Mr. Samuel Insull. An address will be delivered by Hon. Charles Nagel, Secretary of the United States Department of Commerce and Labor.

The new reports include one by Mr. Paul Lupke on "Question Box Revision"; one by Mr. E. L. Callahan on "Electric Signs" and one by Mr. W. R. Collier on "Ornamental Street Lighting." Mr. A. S. Loizeaux will present a paper entitled *Load Reports on an Electric System* at the second technical session on Wednesday morning.

Elaborate entertainment features have been arranged for the week. A reception to President and Mrs. Freeman on May 29 will signalize the beginning of the festivities. At 8:30 p. m. sharp the receiving line, comprising the officials of the association and their wives, will form in the grand ballroom of the Hotel Astor and the reception will be conducted from 8:30 to 9:30, during which time Mr. Arthur Depew, organist of Plymouth Church, Brooklyn, will preside at the magnificent organ in the hotel. A promenade roof-garden concert will immediately follow the reception and will be given on the roof of the Astor, to which the delegates may directly ascend from the ballroom in special elevators. An attractive musical program will be rendered by an orchestra and dancing will take place in the grand ballroom coincident with the roof-garden concert. At an appropriate hour a collation will be served in the Belvedere restaurant on the roof. In the event of inclement weather the promenade concert which will follow the reception will be given in the grand ballroom with dancing.

On Tuesday morning, May 30, there will be a daylight excursion for ladies only on the Hudson River. The steamboat will leave the foot of West Forty-third Street promptly at 11 o'clock and after a trip past the Palisades, Yonkers, Tarrytown, Peekskill, Nyack and other points of interest on the New York and New Jersey shores will return at about 3 o'clock in the afternoon. During the trip a concert will be rendered and luncheon will be served.

On Tuesday evening, May 30, the entire convention will be the guests of the Edison Electric Illuminating Company of Brooklyn, which will provide a steamboat ride through the East River and New York Bay to Coney Island. The excursion will give the delegates an opportunity to view the bridges spanning the East River, the lower end of Manhattan Island, Governor's Island, Forts Hamilton and Wadsworth and other points of interest along the shore, by night. It will also give the delegates an opportunity of seeing the most famous seaside resort in the world in all its glory. The boat will leave East Forty-second Street promptly at 8:15 and will leave Coney Island on its return trip at 11 o'clock.

On Wednesday, May 31, the teams of the Brooklyn and Philadelphia Edison Companies will engage in a game of baseball and in the evening the public policy committee will present its report at the New Theater.

On June 1 the committee has provided entertainment for the ladies at 11 o'clock in the shape of a children's presentation of "Pomander Walk," and in the evening all the assembled delegates and ladies will be the guests of the association at a theater party. Three of the largest theaters in the city have been engaged for that evening. On the morning of June 2 the ladies will be taken for an extensive automobile ride to various points of interest in the city. In the afternoon tea will be served at the Hotel Plaza, and in the evening the Sons of Jove will have a rejuvenation at Coney Island.

On Saturday, June 3, the delegates will be the guests of the New York Edison Company on a steamboat ride up the Hudson and East Rivers, which will also include visits to several important power stations. The party is scheduled to assemble at Waterside Station No. 2 at 10 o'clock and will visit the huge plant of the Consolidated Gas Company at Astoria on the way up the East River. Luncheon will be served on board the boat and the party will be landed at the foot of West Forty-third Street on the opposite side of the city at about 5:30 in the afternoon. Arrangements have been made for golf at a number of nearby clubs and a professional chaperon will be available at the Engineering Societies Building for personally escorting shopping, dining and theater parties for the ladies.

N. E. L. A. Convention Daily.

Coincident with the other preparations to make the New York convention of the National Electric Light Association the most notable in the history of the association the plans for the publication of a *Convention Daily* are being matured carefully. The *Daily* will be published for the association by the *Electrical World*, and its office will be on the mezzanine floor of the Engineering Societies Building. There will be five issues, from May 30 to June 3, inclusive, and they will contain the announcements, outline proceedings and general news of the convention, with some special features in lighter vein. The *Daily* will be distributed without charge every morning to delegates, and it is believed that it will be a valuable record of the many-sided gathering that is in prospect.

The St. Louis N. E. L. A. Convention Special.

So many persons expressed a preference to reach New York earlier than Monday afternoon, May 29, as was first planned for the St. Louis-New York convention special that the hour of departure of this train has been changed to 12:20 p. m. Saturday, May 27. A large number of reservations on the St. Louis special are reported by Mr. F. N. Jewett, assistant master of transportation, who will be in charge of the train. A number of persons from the Southwest and territory tributary to St. Louis have arranged to join the special train there, coming through to New York with the party. An all-steel limited train of Pullman cars is promised by Pennsylvania Railroad officials.

A. I. E. E. Election and Annual Meeting.

At the annual meeting of the American Institute of Electrical Engineers held in New York on May 16 it was announced that the following officers had been elected by letter-ballot of the membership:

President, Mr. Gano Dunn, vice-president and chief engineer of the Crocker-Wheeler Company, Ampere, N. J.; vice-presidents, Messrs. D. B. Rushmore, General Electric Company, Schenectady, N. Y.; C. W. Stone, General Electric Company, Schenectady, N. Y., and W. G. Carlton, New York Central & Hudson River Railroad, New York; managers, Messrs. F. S. Hunting, Ft. Wayne Electric Works, Ft. Wayne, Ind.; Farley Osgood, Public Service Corporation of New Jersey, Newark, N. J.; N. W. Storer, Westinghouse Electric & Manufacturing Company, Pittsburgh, Pa., and W. S. Lee, Southern Power Company, Charlotte, N. C.; treasurer, Mr. George A. Hamilton, and secretary, Mr. Ralph W. Pope. The vote for Mr. Pope, who has been elected secretary for twenty-seven consecutive terms, was greater than the total vote for the two candidates for the presidency.

The proposed amendment to the constitution giving the directors power to appoint the secretary instead of allowing the membership to vote for this office was not passed, although there were 1666 votes for it as compared with 703 votes against it. The constitution states that at least 75 per cent of the voters must declare themselves in favor of any proposed amendment before it can become a part of the constitution.

Prof. Elihu Thomson, as chairman of the Edison medal committee, outlined the conditions under which the medal was founded and announced the award to Mr. F. J. Sprague. The medal, which was founded in 1904 by the associates, friends and admirers of Mr. Edison, is awarded by a committee of the A. I. E. E. consisting of twenty-four members selected by the president and board of directors. The medal bears on its obverse a portrait of Mr. Edison and on its reverse an allegorical conception, "The Genius of Electricity Crowned by Fame." Last year the medal was presented for the first time, the recipient being Prof. Elihu Thomson. Elsewhere will be found an account of the presentation of the medal.

Following the formal addresses of presentation of the medal by President D. C. Jackson and acceptance by Mr. Sprague, four papers were read on subjects relating to engineering activities with which Mr. Sprague has been associated.

Mr. W. B. Potter discussed the development of the electric railway and showed the active part taken in it by Mr. Sprague. Prof. Franklin H. Giddings, of the department of sociology of Columbia University, explained the effect of the electric railway in minimizing the extreme upper and extreme lower classes of humanity and improving the living conditions of the augmented middle class. Prof. George F. Swain, of the department of civil engineering of Harvard University, presented arguments to prove that the substitution of electricity for steam on railroads represents a luxury for the patrons rather than a necessity in almost all cases and should not be forced upon the railroads until it can be shown to be economically desirable. Commander S. S. Robison, of the United States Navy Bureau of Steam Engineering, described the numerous uses to which electricity has been put in the navy, and outlined the early work done by naval engineers in developing electrical appliances.

Presentation of the Edison Medal to Mr. Frank J. Sprague.

Elaborate ceremonies accompanied the presentation at the annual meeting last week of the American Institute of Electrical Engineers of the Edison medal to Mr. Frank J. Sprague for meritorious achievements in electrical engineering. On the stage of the main auditorium of the Engineering Societies Building were seated past presidents, representatives of local societies, civic organizations, national electrical societies, city officials, the medal committee, the medal founders, the speakers of the evening and other special guests, including Mr. Thomas A. Edison. An escort had been provided for distinguished guests who were conducted in procession to the stage. The processional march was started on signal from a bugle and proceeded, accompanied by music, from the south corridor through the outer hall and down the center aisle of the auditorium. Full evening dress, including white tie and gloves, was prescribed for members who escorted the guests.

Following the formal address and presentation of the medal

Frank J. Sprague.

by Prof. Dugald C. Jackson and acceptance by Mr. Sprague, four papers were read on subjects relating to engineering activities with which Mr. Sprague has been associated, one of which, by Mr. W. P. Potter, related largely to the professional career of Mr. Sprague.

In his remarks accepting the medal Mr. Sprague said that he would be remiss if he did not return thanks first on behalf of his beloved alma mater, the United States Naval Academy, where, under the late Admiral Sampson, he had the privilege of being grounded in the essentials of mathematics, physics and engineering, and where he imbibed certain principles, intangible perhaps, but almost inseparable from the training in our great government schools, and which he believes always stand one in good stead in the battle of life. He spoke of the encouragement and ever-present help received from his associates, Johnson and Harding, McPherson, Crosby and Greene, Lundy, Mason and O'Shaughnessey, Carichoff, Hill and Sheppard. Of two of these he spoke with deep feeling—Crosby from West Point and Greene from Annapolis. Each, he said, resigned a commission which was the stepping stone to high rank, influence and possible fame, and cast his lot with a struggling inventor in a new art and an undeveloped field. All through the days of Richmond, often dark ones, and during his absence on account of his critical illness, one in New York and the other in Richmond, fought against heavy odds the

battle of the early trolley. After referring to the untimely death of Lieutenant Greene, Mr. Sprague spoke of the present illness of Lieutenant Crosby, who sent his proxy in the form of a letter, to which Mr. Sprague said he attached more value than to perhaps anything else of its character that could be bestowed.

In the letter, after referring to his illness, Mr. Crosby said that no one can know better than himself how thoroughly the honor associated with the presentation of the medal had been earned. Intimate association with Mr. Sprague—beginning in 1887—warranted him in saying that the great work of giving practical economical value to electric traction was based, to an unusual degree, upon the personal work of Sprague. While he sought and generously recognized the efforts of those who aided in the work, yet his individual ideas were always the guidon, set far forward, toward which the struggling squadrons pressed. Difficulties which to the younger soldiers in the field may now seem but as molehills were veritable mountains then, yet Sprague's indomitable spirit and ready genius never flinched before any obstacle, however high its pathless summit seemed. Within the profession it may be that the accomplishments of Sprague are measured at their true value, but a certain inaptitude for seeking lime-light effects has prevented him from receiving all the popular recognition which his work in traction and in other fields should fairly merit; but the award of the medal will tend to balance the unequal scale. Mr. Crosby referred to Lieutenant Greene—a friend dear to Mr. Sprague and himself—as one who has left a memory that is a sweet fragrance. "Old memories of successful struggle and friendly recognition from co-workers in an art, these are the best rewards that come to those who, like Sprague, have victoriously led the forces of progress."

In the course of his remarks, Mr. Sprague said that he was once asked the somewhat difficult question as to just what he considered his particular status and work, and what were his mental processes in what the questioner termed invention. To this inquiry he had, in all candor, to reply that he was simply a constructive engineer, with enough of inventive faculty or imaginative equipment to effect a basis for activities, and an immature financial sense sufficient to entangle himself and his friends in industrial development; to which perhaps might have been added, the possession of enough self-assurance to be willing to venture a long way in support of conclusions arrived at, and a love and capacity for work. As to the mental processes, they are those of an engineer who seeks the solution of problems as they arise. Mr. Sprague said that while this is not strongly individual, and does not spell genius, yet he is content that it is so.

Mr. Sprague expressed the opinion that chance largely determines one's activities and one's success or failure in life, and in this connection the award of the medal to him has a special significance in relation to early associations, to which he then proceeded to make brief references. His cadet life at Annapolis, he said, covered the period when Bell, Gray, Farmer and Edison were arousing the imagination of the scientific world, and some knowledge of their endeavors penetrating the circumscribed surroundings of naval routine, aroused in him a spirit of restlessness. On his way home after graduation he called to see Mr. Edison to explain to him a telephone invention; and later, in 1881, while off Hampton Roads on the training ship Minnesota, he planned to light the ship with electricity from an Edison dynamo, to be driven from the flywheel of an old dismantled steam pump, which scheme did not come to fruition because Mr. Edison could not approve of the proposed motive power. Later he served, in 1882, as juror at the Electrical Exposition in Sydenham, England, and after making a formal report to the Navy Department recommending the general use of electricity in the service, he left the naval service and entered Mr. Edison's employ as assistant. It was during this period, while riding on the Metropolitan underground railroad of London, that his conception of an electric trolley system first took definite form. He recalled the surprise, when in 1883 he reported for duty to Mr. Edison, with which the news was received that Mr. E. H. Johnson had promised him the munificent salary of $2,500, the manner of Mr. Edison betokening a doubt as to his earning capacity.

After a period of activity in connection with the earlier central stations, which was also a period of personal and independent work in stationary-motor development, a request that he should leave the construction department in order to undertake some calculations in relation to the transmission of power, which would have led to an interruption in lines of work in which his interest was increasing, caused him to enter a protest with Mr. Edison, to which the following reply was received: "Sprague: As the construction department is about to be given up, I think the better plan would be for you to resign. Edison." Mr. Sprague said that he did resign and that this is the real reason why he is the recipient of the Edison medal. No man, he said, who thinks that he has within himself the capacity for a reasonable share of independent development, and who wishes to carve out his own career, can ever remain the agent of any one, and surely not the subordinate of a man of such intense activities and of so dominating a personality as that of the great inventor who has left such an imprint upon his age and whom all delight to honor.

Referring to the engineering profession, he said that the difference, for example, between a lawyer and an engineer is that the former is destructively inquisitive and the latter inquisitively constructive. The engineer is trained not only to ask questions and find weaknesses, but to correct them, to build up and not to pull down, to create and not to destroy. His training is along the lines of exactness. Honesty in investigation and conclusion, in design and construction, constitute the very foundation of professional ethics. There is no room for high finance or crooked practice in the determination of strengths of material, centrifugal or centripetal forces, or the factors of safety. The engineer is a necessity because he is the connecting link between conception and realization, between capital and dividend.

Mr. Sprague said that it was his belief, founded on considerable experience, that most inventions of importance are rarely inspirations, but are the simple practical solution of engineering problems presented in the natural course of events, and often are supplemental to, or the logical result of, preceding inventions. This view was illustrated by some of his own experiences. The conception of the trolley system was largely due to the study of Edison's lighting system and circumstances of daily travel on the London underground railway. When he first undertook to solve the problem of making a motor operate at constant speed on a constant-potential circuit under a varying load, he first thought to use a centrifugal governor, but, after studying the theory of the shunt-wound motor, reasoned that since the work done was dependent on the current, and this in turn was determined by the difference of the line and motor emfs and the amount of resistance in circuit, all that was necessary was to change automatically the only variable—the counter emf. Then, too, it seemed as if the motor could be considered, in a certain light, as a dynamo driven by a current whose emf was a function of armature speed and field strength. It followed therefore that to get a constant speed under varying load the field strength should be automatically varied by a reverse winding in series with the armature, which, when the load was increased, would first weaken the field with increase of current on a reduction of speed and would be so proportioned that it would properly restore the speed to normal in a weakened field. This formed the basis of considerable controversy at the time—1884—because it seemed contrary to normal conception. Having got constant speed, the next problem was to overcome the sparking on the commutator, which appeared to necessitate the backward setting of the brushes with increasing current and load. A mechanical movement not proving satisfactory, it followed that the proper thing was to rotate the field in an opposite direction by a series field winding, which had a

polar axis at right angles to the normal one, and which would automatically create a corrective resultant.

Mr. Sprague similarly referred to the circumstances which led to the wheelbarrow method of mounting railway motors, and his invention of the multiple-unit system of train control. The last invention, however, was rather inspirational than a logical engineering solution of an existing difficulty. Earlier experiments on rapid transit by electric trains had indicated the necessity of a large proportion of weight on the drivers, and hence the distribution of motors throughout the train. Having in electric elevator development to deal with the idea of distant electrical control, the idea suddenly came to him to individualize the equipment of each motor, and then from one or more master switches simultaneously operate the controller of each equipment.

Generally speaking, he said, it is not invention which demands the most effort or the largest expenditure of time in the electrical field, for the greater burden is found in the grinding experiences of commercial development, overcoming of prejudices, the removal of faults, recovery from failures, and especially the raising of capital and maintaining the courage and confidence of the investor until a dividend is in sight.

In conclusion, Mr. Sprague said that in the engineering profession there are always new paths to blaze, fresh histories to make, unending worlds to conquer. The heritage of greatest value which we can leave to those who bear our names will be that of high aims realized and creative work well done; and the Edison medal will prove a constant and effective incentive to the attainment of the worthy object of any man's honorable ambition.

The paper by Mr. W. B. Potter on the development of the electric railway included an appreciation of the work of Mr. Sprague, from which the following abstracts are made.

Mr. Potter stated that after entering Mr. Edison's employ in 1883 while on a year's leave of absence from the navy Mr. Sprague, in association with Mr. W. S. Andrews, inaugurated in Sunbury, Pa., the first Edison overhead three-wire lighting system, and he was given charge of the installation in Brockton, Mass., of the first Edison three-wire underground system.

The nature of his work with the Edison Construction Company led to greater opportunity for mathematics than for invention, and he consequently resigned and, in association with Mr. E. H. Johnson, organized the Sprague Electric Railway & Motor Company in 1884. The early work of this company was principally with stationary motors, Mr. Sprague designing a differentially wound constant-speed motor, which was exhibited at the Philadelphia Electrical Exposition of 1884.

Mr. Sprague in the meantime had not lost his interest in the electric railway, which began during his association with the Crystal Palace Exhibition, his travels on the London underground adding zest thereto. It was, in fact, at this time, in 1882, that Mr. Sprague devised the modern trolley system, an overhead conductor with a universal upward pressure contact. Later, when applying for a patent and being in interference, he lost date on a technical ruling as to date of invention, for though he was a naval officer on foreign duty, his legal date of invention was only coincident with his arrival in this country in 1883.

Being now in a position to put his ideas into effect, he began, in 1885, the construction of the motors that were used in the Durant Sugar Refinery and Manhattan Elevated demonstrations. The success which attended these first efforts gave such encouragement that Mr. Sprague was able for the first time in the history of the electric-railway development in this country to secure sufficient capital to undertake commercial exploitation on a large scale. The equipment of the Richmond railway and the inauguration of public service on this road, Feb. 3, 1888, was one of the great events in railway history.

As evidence of the public interest at this time, the following has been taken from a circular call to a mass meeting on transportation in New Orleans under date of Dec. 2, 1889: "Lincoln set the negroes free, Sprague has set the mule free. The long-eared mule no more shall adorn our streets."

A number of roads in this country and abroad were equipped by Mr. Sprague prior to the absorption of his company in 1890. Between the years 1890 and 1897 Mr. Sprague gave his attention principally to electric-elevator design, and it was in connection with this work that the multiple-unit idea first occurred to him. The first experimental multiple-unit train was, in fact, equipped in part with devices such as are used in his elevator service. Although not active in railway development during this period, Mr. Sprague still maintained his interest. Having occasion to test the mechanism of a number of elevators in the same building, he arranged a master switch in the basement from which any one elevator could be operated or several simultaneously. It occurred to him that a similar control applied to a train on which each car was equipped with motors would offer a new and better solution of train operation. The result of this idea was the multiple-unit control.

Among the many inventions for which we are especially indebted to Mr. Sprague, and which are now in general use, should be mentioned his method of suspending railway motors on their trucks, his distribution system for trolley lines, the series-parallel connection of railway motors, the application of a master controller to the remote control of a main controller, an electric throttle for regulating the acceleration of cars, and the multiple-unit control.

Mr. Sprague's work in connection with the American Institute of Electrical Engineers, of which he is a past-president, as a member of the commission which passed upon the electrification of the New York Central and his services as consulting engineer need not, Mr. Potter said, be emphasized by further comment.

Mr. Sprague on all occasions has shown the courage of his convictions, pledging his own resources and being gifted with the ability to secure the pledge of others to carry out his work. He has further exhibited unusual energy in developing his ideas into practical form and carrying them through to commercial success, and to this result he has been greatly aided by the spirit which his unbounded enthusiasm has created in his associates.

In conclusion, Mr. Potter said that, although at times given to prophesying, Mr. Sprague is more fortunate than the prophets of old, in that he has lived to see many of his predictions become realities.

Electric Vehicle Club Meeting.

The regular meeting of the Electric Vehicle Club of Boston was held at the Edison Building on May 17, with Mr. N. Rommelfanger in the chair. At the conclusion of the usual luncheon committee reports bearing upon the questions of advertising electric vehicles by large signs, publicity in the daily press, exhibits and parading were received. Secretary L. D. Gibbs announced that one of the most prominent billposters in Greater Boston is considering an installation of electric vehicles capable of carrying paste cans, brushes, framing material and two or three men, together with an electric or gasoline truck for lumber transportation. Attention was called to the fact that the portable house of the Boston Edison company was carried from Dover to Winchester on electric trucks, and the possibilities of securing an all-electric billboard service were touched upon. Detailed consideration is being given by the Edison company to the location of the large signs advertising electric vehicles which have been authorized and which will be, in general, 35 ft. long and 25 ft. high, as recently stated. Mr. W. H. Francis emphasized the importance of calling upon the Edison company's engineers in connection with the design of sign supports, stating that in certain cases where the sign manufacturers' specifications had been followed in detail no little trouble had arisen from inadequate strength in the supports.

An extended discussion took place regarding the wisdom of maintaining electric trucks for demonstrating purposes, the general opinion being that the policy is of doubtful value except in cases where the prospective customer is clearly interested in

results, and perhaps willing to meet a portion of the cost. One day's trial service was generally conceded to be a poor index of the economy of the motor vehicle. Regarding publicity, Mr. W. H. Atkins, general superintendent of the Boston Edison company, offered for pushing the electric vehicle the free use of space in forty-six suburban weeklies now taken by the company. Mr. E. S. Mansfield showed a sample inquiry card sent to garages by the rate committee for the purpose of securing data upon service and cost of existing installations. The committee on window displays called attention to several enlargements of electric-vehicle photographs on exhibition in the Edison company's window and announced that additional displays are to be forthcoming. The committee on the parade of electric trucks for May 30 reported increasing enthusiasm among owners of these vehicles and a general disposition to enter machines and products in an effective comparison with the work-horse procession.

At the close of the meeting a 5-ton truck of novel design was exhibited by Mr. W. E. Eldredge. The truck is the first of its kind ever built, and its unique feature consists of the employment of steel-tired rear wheels in place of the usual rubber-tired equipment. The truck is equipped with two motors capable of delivering 18-hp maximum, couple-gear wheel drive, has a platform 19 ft. long and 5 ft. 6 in. wide and a capacity of twenty-five sugar barrels. Its battery equipment consists of forty-eight Nation cells with twenty-one plates each. The front-wheel diameters are 38 in. and the rear-wheel diameters 54 in. The motors are installed in the front wheels, the rear wheels being provided with tires of steel band, 4 in. wide and 1¼ in. thick. The truck is designed for a maximum speed of 5 miles per hour loaded, with a short-haul service under urban conditions, and it is estimated that the use of steel tires on the rear wheels will save about $2 per day, the total cost of operating the truck being about 50 per cent of that of a gasoline truck of the same capacity.

Kentucky Electric Company's New Station at Louisville.

Work is already well advanced on the new generating station of the Kentucky Electric Company of Louisville, which has been designed for an ultimate rating of 64,000 kw. The site occupies an Ohio River frontage of 305 ft., extending back 396 ft. to a 200-ft. front on Washington street. The section of the building first to be completed will be capable of housing 16,000 kw of equipment. Of this there will be installed at once one 4000-kw and one 2000-kw horizontal General Electric steam turbine, in addition to the three 1500-kw vertical turbine units to be transferred from the present plant. A rather unusual feature of the new station will be the condenser well, required on account of the 45-ft. rise and fall which the Ohio River undergoes at this point. The well comprises a circular pit, 30 ft. in diameter and 72 ft. deep, lined with a concrete wall 4 ft. thick and loaded to guard against flotation due to change in river levels. In this pit will be located Alberger vertical surface-type condensers. Adjacent to the plant will be a coal-storage yard, 65 ft. x 305 ft., which is spanned by a motor-operated gantry crane for coal handling. The new station is to be ready for operation by December, 1911. Col. R. E. Hughes is president and general manager of the Kentucky Electric Company, and Mr. L. S. Streng is chief engineer. The consulting engineers for the new station are Sargent & Lundy, Chicago.

Underground Electrolysis in New Orleans.

The New Orleans Sewerage and Water Board has become involved in a controversy with the New Orleans Railways Company, which controls all the street railways of the city, as to the responsibility for the damage to the large and costly city water-works system by underground electrolysis, due to the railway return current, and it is probable that the matter will be taken to the courts. It is claimed that one of the 20-inch mains, near one of the power stations, was found to carry a current of 420 amperes, or about one-fourth of the entire output of the station. The damage, it is claimed, has been going on for about four years, and a bill for $3,000, covering a period of not more than four months, has been rendered to the Railways Company.

There are three large power stations supplying the railway system at 500 volts, and the damage is estimated approximately to extend to at least a half mile in every direction from each station.

Extensions to St. Louis' Underground District.

The lighting department of St. Louis, Mo., has under contemplation an ordinance adding 133 blocks to the underground district of the city. The new underground districts are: Grand Avenue from Market Street to Kossuth Avenue, Kings Highway from Market Street to St. Louis Avenue, and Union Avenue from Market Street to St. Louis Avenue. The present underground district, as fixed by the city in 1898, is bounded by the Mississippi River on the east, west by Twenty-second Street, north by Lucas Avenue, and south by Spruce Street.

Manufacturers and the Patent Situation.

At the meeting in New York City of the National Association of Manufacturers on May 16 to 17 a committee on patents submitted a report which, after giving details of recent new laws, regulations, etc., discusses the United States patent system in general terms.

The opinion is expressed that the majority of people have an altogether erroneous idea as to the value and effect of patents. Politicians for years have echoed the cry that one of the glories of our American civilization is our patent system, but it would be nearer the facts to say that the resourcefulness and ingenuity of the American inventor has raised this country to the position it occupies in the mechanical world, not *because* of our patent system, but *in spite* of it. While there can be no question that the theory of the system is good, in practice there is much that is altogether bad. The procedure in the Patent Office has become unreasonably complicated and intricate, due mainly to the effort to carry out an impracticable ideal, namely, the formulation before the grant of a patent of claims defining precisely the scope of the invention. This procedure has been made the more difficult by the attitude taken by courts many years ago concerning combination claims which has led to a technically strict interpretation of the claims that prevails nowhere else in the world, and to combat which attorneys are compelled to draw numerous claims of various degrees of scope. Interference practice has also become so complicated and intricate that it involves inventors in needless expense and delay in the effort to carry out another impracticable scheme, namely, that of having the Patent Office, which is an administrative bureau, undertake the judicial function of determining questions of priority of invention.

Because of delays due largely to the two foregoing features, manufacturers and the public generally are subject to serious detriment and hardship through being unable to determine what they may safely manufacture or use, it being common experience for patents to be issued (as in the case of the Berliner patent) many years after the inventions have gone into general use, and in many instances these belated patents have the effect of destroying investments made in good faith in the ignorance of the existence of the rights which subsequently matured in such patents.

After a patent is granted, both the patentee and defendants are subject to great difficulties in securing prompt adjudication of suits. It takes too long to obtain a decision in the patent courts and the procedure is too expensive for an individual inventor or a small corporation. If patent cases were tried in an open court, as they are in Great Britain, a decision would be

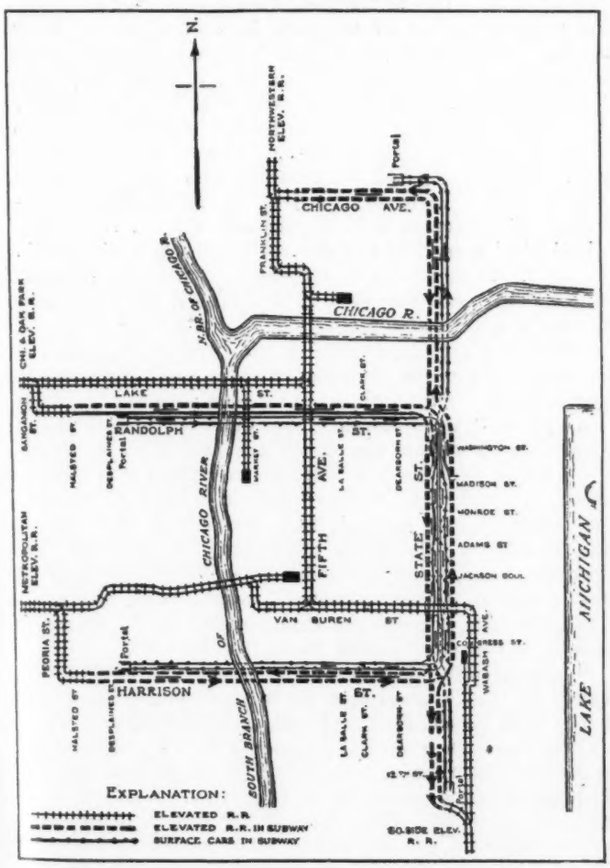
reached in a fraction of the time now necessary, and the cost would be in many cases greatly reduced. Such an enormous mass of precedents have been created by the courts and the principles of the patent law have become so over-refined that the attainment of a just result in infringement litigation is needlessly hampered.

While in the consideration of questions of fair competition, as an example, the courts have no difficulty in applying simple and common-sense rules in deciding a patent question, the case is likely to hinge on some abstract principle of patent law that may have been sensible enough in the case where it originated, but which cannot be fairly applied to other cases with different facts and under entirely different conditions. The committee believes that if patent cases could be tried in open court so that a judge would have the opportunity of seeing the witnesses and excluding irrelevant and immaterial testimony, there would be a better chance of the case being decided correctly than when the attempt is made to digest an enormous amount of evidence taken outside the court and upon which the court seeks to decide the case on abstract principles.

In conclusion the committee says that the only way in which reforms in these matters can be brought about is by the awakening of public sentiment, and this end can only be secured by continual agitation upon the part of those who are vitally interested in these questions, so that such a popular demand can be created for the necessary changes that action thereon cannot be denied.

Chicago Subway Situation.

The transportation committee of the Chicago City Council began its investigations preliminary to a selection of the subway plans offered by contributing engineers at a meeting on Monday afternoon, May 21, when Mr. Bion J. Arnold appeared to explain his plans, outlined in the *Electrical World* of Feb. 16. At the later sessions Messrs. John Ericson, former city engineer; George W. Jackson and R. C. St. John, former assistant subway engineer under Mr. Arnold, submitted their ideas to the committee. The hearings are to be completed during the present week, and the council committee will render its decision as soon as possible thereafter.



Map Showing Proposed Subways in Chicago.

Reduced cost of construction, together with through-routing to all sections of the city, are the features which distinguish the St. John plan of subway, the cost of which would be only $15,000,000, it is declared. Five and one-half miles of underground construction are contemplated, containing 21.5 miles of single track at a cost of $700,000 per track-mile. It is proposed to continue the present stub terminals of the elevated roads, utilizing also two sides of the present Union Loop structure, on Van Buren and Fifth Avenue, although later replacing these overhead tracks by subways. There would be no grade crossings in the subway system proposed, but the high level adopted would make it impossible to use the existing river tunnels with this system. Room under the streets is left, however, for a low-level subway above the freight tunnels, which could be utilized for a high-speed subway system later. The hourly capacity of the subway proposed by Mr. St. John is estimated at 250,000 passengers. On State Street, where the subway planned contains two tracks of the elevated railways and four of the surface lines, the sidewalks would be widened to 30 ft. to accommodate the station entrances. Under Harrison and Randolph Streets four tracks would be provided—two for surface and two for elevated-road traffic. The north-and-south State Street subway, from Chicago Avenue to Twelfth Street, with a Franklin Street branch to the Northwestern Elevated railway and a Harrison Street branch to the Metropolitan West Side Elevated system, is estimated to cost $7,500,000. Approximately the same amount would be required for the east-and-west subways in Randolph and Harrison Streets, each extending to portals near Desplaines Street. Chicago now has approximately $6,000,000 available for subway construction, besides an additional income of $1,500,000 per year which can also be utilized for this purpose.

Electric Motor Discussed at Joint Meeting of Engineers at Boston.

At a joint meeting of the Boston sections of the American Institute of Electrical Engineers and the American Society of Mechanical Engineers with the Boston Society of Civil Engineers on May 17, Mr. Fred M. Kimball, of the General Electric Company, read an illustrated paper on "The Electric Motor in the World's Work." The author reviewed the history of motor design and showed that the electric motor has grown from insignificant beginnings to units capable of delivering 20,000-hp each for short periods; while efficiencies have been carried close to 95 per cent. The present annual output of motors aggregates about 1,000,000 hp. Turning to the general question of electric driving, the speaker pointed out that safety, convenience, low maintenance cost and increased production are the objects rather than substantial reductions in the cost of power. Mr. Kimball said that while the general trend of the times is toward individual driving, it is advantageous to use group driving in many cases where a number of tools run from a single motor are similar in design and operating characteristics, and particularly where the individual cycles of performance do not occur in synchronism. When this is the case the diversity factory of the current demand of the group-driven tools enables a smaller motor to be used than where a separate motor is applied to each machine, with resulting reduction in first cost. The overload capacity of the large single motor used in driving the group is generally sufficient to handle momentary peaks of severe character. Thus six wood turning lathes may be driven in group by a 2-hp motor, whereas if individual motors are employed six ½-hp motors may be required. In equipping old tools for electric operation the group-drive often appeals to the manufacturer on account of its lower cost. Where the cost of power is small, the sav-

ing in investment by utilizing group drive is frequently sufficient to offset the operating economies of the individual installation.

The well-known advantages of individual driving were reviewed, the chief being the increase of production almost always resulting. This may be from 5 per cent up. An additional output of even a foot of cloth per hour in a modern loom attracts the manufacturer. Backlash, slipping of belts and distortion of shafts all waste energy, but more than this, retard production. The load factor is better with individual drive, and the possibilities of metering the service and checking the tool performance are not yet fully utilized. Where energy is purchased, the individual drive tends to effect savings in monthly bills. The speaker contended that a maximum of three bearings of the self-aligning or roller type should not be exceeded in a group drive, in order to obtain the best results. Too much care cannot be taken to avoid poor alignment, a recent case showing a loss in energy valued at $4 per day in a single factory. The line shafting must be short and the alignment frequently checked, and in new installations the center of gravity of the system should be kept as low as possible. Short belts are advantageous in applying motors to heavy machines, and the modern chain drive has many features of attractiveness.

Mr. Kimball commended the modern cloth pinion, which is one of the latest developments in machine gearing, stating that its strength is nearly double that of a rawhide pinion, with the advantages of silent operation, independence of the action of moisture, heat and cold, and immediate adaptation to the shape of the gear teeth. A pressure of about 9 tons is used in forming these pinions, an excess pressure being inadvisable on account of its tendency to cut into the fibers. In conclusion the speaker stated that about 25 per cent of the textile mills of America are electrically driven. All American industries consume about 20,700,000 hp, and of this from 15 to 18 per cent is electric. There is thus an attractive field for large future applications of electric driving in modern industry.

The Easter Sessions of the Société Française de Physique.

By S. H. Russenberger.

Each year in the fortnight following the Easter holidays the Société Française de Physique holds at Paris a meeting and exhibition intended to bring before its members, who often come from a great distance, the principal scientific happenings of the year. Foreign savants are always present to give an account of their own work, and this year papers were presented by a Dutch, a German and an English scientist.

The Dutch visitor was Mr. Zeemann, to whom is due the discovery of the splitting of the rays of the spectrum by the action of a magnetic field. In examining the spectrum of the sun or of the stars one often sees rays thus divided, which would indicate that the light of these bodies undergoes the action of a magnetic field. Particularly is this the case with the light from sun spots, which Professor Zeemann holds are nothing but a sort of gigantic aurora borealis belonging to the sun.

The German scientist, Mr. Planck, very ably demonstrated that the kinetic theory of Boltzmann, suitably modified and completed by a corpuscular theory of energy, gives to the problem of the relation between energy and temperature a solution much more satisfactory than that furnished by thermodynamics alone.

Sir William Ramsay, the English representative, who is the discoverer of argon, neon, crypton, etc., has recently been occupied in weighing the extremely light quantities met with in the study of radioactivity. He exhibited to the conference minute scales made of quartz filaments which under the microscope indicated weights to the three-millionth part of a milligramme.

Professor Langevin, of the College of France, showed and described numerous interesting experiments that had been performed with a simple quadrant electrometer. Professor Langevin hopes to see the electroscope now used in schools and colleges disappear and be replaced by the electrometer, which will be of much greater value for educational purposes.

The final paper presented was by Commandant Ferrié, who described the wireless-telegraph station of the Eiffel Tower, which his hearers went in a body to visit. This station is particularly remarkable because the antenna is supported by a tower 300 m in height, which permits the receipt of communications from a great distance, even from America. Thus the visitors were able to read in the dispatch book messages that a gentleman signing himself Charles and another gentleman signing himself Adolphe sent to Mlle. Polaire at the moment when that charming actress started on her return to France. These two gentlemen will doubtless be less enthusiastic over the great modern discovery when they learn that their declarations were readable more than 5000 miles beyond the beloved object to whom they were sent. The writer placed his ear to the telephone receiver, but did not have the good fortune to hear a communication of this importance. He simply received the time of day from the station at Gibraltar, situated 900 miles from Paris.

The members then went to visit the two transmitting posts, one of 70 kw, which sends the time to ships in the Red Sea and to the scientific stations of Canada, and the other of 10 kw, which members were permitted to operate. By varying the excitation of the generator it was possible to make vibrations more or less rapid, which produced different sounds. A lieutenant played for the visitors a tune as from a trumpet upon this novel instrument.

Commandant Ferrié drew attention to the sparker at this post. This is formed of a disk opposite which is placed perpendicularly a metallic tube through which passes a strong current of air. This arrangement has the advantage of obviating the wearing out of the parts between which the spark appears. Thus the frequency given is preserved exactly, which is not the case with sparkers in the form of a ball or a point.

The exhibition, as is the case every year, consisted entirely of inventions not yet placed on the market. Even the exhibition rooms were lighted entirely with apparatus invented in the past year. The motive power was furnished by a petroleum engine without valves, the latest novelty of the automobile manufactories. The valves, so easily clogged with dirt, are replaced by a kind of slide made of two sleeves, one of which slips within the other. These sleeves have openings properly placed so as to permit the usual four-cycle events. The speed is regulated by modifying the period during which gas is admitted.

Certain new arc lamps exhibited differ from the old ones in the composition of the electrodes, more or less mineralized, in special forms of mechanism, or in the total absence of mechanism. In the "Astra" lamps of M. Cibié the two electrodes descend by their own weight, the one parallel to the other. The negative electrode is arrested by an inclined stop of non-oxidizable metal. The positive electrode is supported upon a stop carried by the negative, from which it is separated by insulating disks. The arc is magnetically blown toward the lower extremity of the electrodes below the "economizer," a sort of ring of refractory material, which, owing to its excluding oxygen, prevents the electrode that would otherwise be used up first from burning faster than its mate.

In contrast with this device are two lamps absolutely new—that of M. Claude, based upon the incandescence of neon, and that of MM. Urbain, Feige and Scal, in which a very powerful arc plays between a vertical tungsten electrode and mercury. In the latter lamp the light is due both to the incandescence of the tungsten and to that of the mercury vapor. It gives a white light, with very little violet. To start the lamp it is necessary only to shake the mercury a little. The models shown operated at 14 volts, 30 amp, and gave a candle-power for 0.45 watt.

M. Claude's tubes do not consume more than 0.5 watt per candle-power when they are at least 40 m long. When they are only 5 m long the consumption increases to 0.75 watt because of the great drop in potential at the electrodes. Although very much like mercury-vapor tubes, and especially the Moore

tubes, in their form, yet they are widely different from these in their operation. In fact, while there is required an emf of 300 volts per meter to produce the incandescence of nitrogen, an emf of only 120 volts is necessary to produce that of neon. Tubes 45 mm in diameter give from 200 cp to 250 cp per meter with neon and only from 40 cp to 50 cp with nitrogen. Finally, and more important than all, under favorable conditions they can work without valves. It is necessary to purify the neon carefully, condensing impurities at the temperature of liquid air in carbon made from cocoanut. Neon emits a superb red light, which sometimes appears to be yellow-orange. The ladies greatly appreciate this method of lighting, which enhances their natural color. It is very certain that in no circumstances would they ever give preference to the mercury-vapor lamps.

The lighting scheme was brilliant, but the exhibition was worthy of it. There may be mentioned an ingenious combination of apparatus by M. Boucherot, a Wheatstone bridge to measure the resistance of armatures in process of manufacture. The current in the bridge is that which traverses the armature. The latter constitutes one of the arms of the bridge, and it is prolonged by a shunt which absorbs 0.1 volt and forms the second arm. The two other arms include a voltmeter and an adjustable resistance. The galvanometer serves equally well as a millivoltmeter. It can when desired be used to measure the current when the latter is diverted to the shunt. It is possible thus without interrupting work in process to determine all the conditions of operation—current, voltage, mean temperature, etc. The apparatus is completed by a thermoelectric arrangement which consists of a galvanometer connected to a thermocouple which is applied to the armature segments to determine the temperature.

In the realm of wireless telegraphy MM. Le Doyen and Ancel showed an electrolytic detector of a special form which is placed upon the hook on which the telephone receiver is hung. The detector is thus not in circuit with the antenna unless the telephone is taken from the hook.

M. Turpain has shown, by means of knitting needles so placed that they serve as a detector, that the antenna is charged progressively at the approach of a storm and becomes more conductive. He has constructed an apparatus which registers this variation of conductivity up to the moment when the discharge occurs. The apparatus indicates the arrival of a storm many hours in advance, often when the barometer has indicated nothing. M. Turpain also exhibited a wireless-telegraph installation which had been struck by lightning without disastrous results. The register had been protected simply by the self-induction of a very short elbow in the cable connecting the antenna to the apparatus.

Coming to the exhibit of M. Herrgott, without quitting the field of electricity one enters that of heat. M. Herrgott makes carpets, cushions, gloves, filters, etc., in which the yarn or thread consists of a nickel filament covered with wool or cotton. Rheostats permit the temperature of the fabric to be graduated with great precision.

The new silica tubes so much employed to-day in chemistry have been adapted by the firm of Grivolas to radiators. The current passing through the conductor within the tubes brings them easily to a red-white heat.

In optics a very interesting field-glass attracted attention. This was invented by M. Violette, a naval lieutenant, for use in target practice. The recoil of artillery has often caused accidents to those whose duty it is to watch the shooting through a field-glass. In adapting to the eye-piece an optical system requiring a long focus the necessity of applying the eye to the metallic mounting was obviated. M. Violette has thus been able to make a glass composed of a cylindrical tube about 30 cm long and 8 cm in diameter. This tube contains the lenses and is extended by a sort of cup made of india rubber, at the bottom of which a hole is pierced. This hole indicates exactly the place where the eye should be applied. The observer can look through the glass during the shooting. At the instant of recoil the india-rubber cup simply forces itself lightly against his eye.

M. Ch. E. Guillaume, assistant director of the International Bureau of Weights and Measures, the ardent advocate of absolute units of measurement, exhibited this year new apparatus which carried still further exactitude of measurement. There were, first, a standard weight of 100 grammes in tantalum, a metal as hard as platinum-iridium, and costing only one-seventh as much, and, second, a simplified linear comparator of average precision, which is made to a scale divided into fifths of millimeters and is intended chiefly for the work of standardization laboratories. The Chinese government has acquired a first model of it. It enables verification to the hundredth of a millimeter to be made in a few minutes.

Space does not permit further description, but it will be understood that no attempt has been made to give here an account of the numerous exhibits of scientific apparatus and experimental arrangements shown that do not relate directly to electricity.

Wisconsin Commission News.

The Wisconsin Railroad Commission has authorized the Janesville Traction Company to issue 1250 shares of common stock, of the par value of $100 each, and $50,000 par value of 5 per cent, thirty-year first-mortgage bonds in denominations of $1,000 each for the purpose of acquiring the property and franchises of the Janesville Street Railway Company, which were purchased at the foreclosure sale on April 5, 1910, by Hodenpyle, Walbridge & Company. This company owns all of the outstanding bonds and 350 of the 500 shares of stock of the Janesville Electric Railway Company, and is organizing the Janesville Traction Company.

It appeared from the petition in the proceeding that the outstanding bonds of the Janesville Electric Railway Company at the time of the foreclosure aggregated $75,000 and accrued interest, evidenced by unpaid interest coupons, amounted to $89,754, making a total indebtedness of $164,754. The outstanding stock at the time of the foreclosure sale amounted to $50,000. In addition to this there were issued during the foreclosure suit by the receivers appointed in the suit, for improvements under the order of the court, receivers' certificates to the amount of $10,000. The aggregate of stock, bonds, etc., at the time of the receivers' sale was $224,754. Under the law a purchaser at a foreclosure sale may organize and issue stock and bonds to an amount not to exceed the total amount of stock, bonds or other evidences of indebtedness outstanding against the company. No valuation of the property was made by the commission.

The commission has been sending out blank report forms to the various utilities operating in the State calling for information as to methods used by the utilities in connection with the uniform classification of accounts. The object is to determine how well the utilities are complying with the requirements as well as to give the commission certain facts and statistics for its own information.

Maryland Commission News.

The Maryland Public Service Commission has been engaged in hearing the application of the Susquehanna Transmission Company to issue bonds for $1,131,000, the proceeds to be used in discharging an obligation to the Susquehanna Water and Power Company. The borrowing company, which erected the poles and wires conveying energy from the Susquehanna River to Baltimore, has a normal capitalization of only $500. Chairman Ambler, of the Public Service Commission, declared that the issue of $1,131,000 of bonds by a corporation with a capital stock issue of $500 was unprecedented to his knowledge. Attorney Homer, who is representing the transmission company, pointed out that this borrowed money had already been expended, and it was the duty of the debtor company to comply with its part of the agreement and issue the bonds. The question of whether it would be fair to place negotiable bonds

such as those proposed by the Susquehanna Transmission Company on the market when they were so scantily secured was debated freely. Mr. Homer gave a résumé of the formation of the transmission company, declaring that in reality it was merely a subsidiary company of the Pennsylvania Water and Power Company, made necessary by the laws of Pennsylvania and the limited character of the power company's charter of incorporation. He declared that when it became necessary for the company to expand its service it became necessary for it to have a transmission line. It could not do this under its own charter and, therefore, the Susquehanna company was formed, and money advanced it for the construction of its lines. This was all done prior to the establishment of the Public Service Commission in Maryland. The application was held under advisement.

Mr. Francis I. Mooney complained to the commission last week because he was compelled to pay the regular rate of $2.50 for thirty calls per month, or an average of 8 1/3 cents per call, when messages can be sent out from pay stations for 5 cents. He has asked the commission to investigate the business methods of the Chesapeake and Potomac Telephone Company. W. Baldwin & Company also made a complaint to the commission stating that they were charged with more 'phone calls than they actually used, and they also request an investigation. All of these matters will be decided when the commission renders a decision on the case which is now before it and which will show one of the most exhaustive studies of the telephone situation ever made in this country.

Ohio Legislative Notes.

The conference committee of the Ohio Legislature, which has been considering the Winters public-utilities bill, has announced that it will not be ready to report until after the recess, which will extend to the end of the month. At best the Legislature will be in session for only a few days then, and it now seems rather doubtful whether action can be taken on the bill at this session. However, many measures are pushed through at the last moment and this one may meet with the same fortune.

The Young telephone bill was reported out by the railroads and telegraph committee of the Senate, when it became apparent that the utilities bill would not reach a vote in the House before the recess. Its friends explained that the bill had been held up because the utilities bill contained about the same provisions and its passage would have accomplished the purpose desired. This bill was amended in such a way as to put the telephone companies under the supervision of the Railroad Commission instead of establishing a special commission, as was originally provided. An amendment has also been inserted which will prevent the inflation of securities in the event of reorganization under any merger that may occur. It was explained that the companies want a bill that will allow consolidations, but that they do not object to reasonable amendments to the present bill. Although efforts were made to advance the bill, this could not be done and it will have to take its chance at the last of the session.

Some of the laws enacted by the present Legislature are as follows:

The Finley bill requiring property owners to permit telegraph and telephone employees to enter properties to repair lines.

The Meinhardt bill granting telephone companies and telegraph companies the right to place their wires underground outside of municipalities.

The Green workmen's compensation bill, which establishes a State fund from which to pay damages for accidental injury of employees. This fund is sustained by fixed contributions from employers and employees in the ratio of 90 per cent and 10 per cent respectively. Employers are at liberty to accept the plan or proceed under the common law, with the exception that a number of their defenses are taken away if they do not operate under the provisions of the bill.

Massachusetts Legislative News.

Governor Foss has signed the following bills of interest to public-utility companies: Resolve 52, which provides that the Boston Transit Commission shall include in its next annual report an estimate of the cost of substituting a subway for the present elevated railway structure between the North Station and Sullivan Square; Chapters 95 and 96, authorizing the towns of Plymouth and Sandwich to purchase securities of the Plymouth and Sandwich Street Railway Company; Chapter 108, authorizing the town of Danvers to sell and distribute electricity to the Middleton Electric Light Company, Middleton and North Reading; Chapter 200, authorizing the town of North Attleboro to incur indebtedness for the purpose of securing a location for the Boston & Providence Interurban Electric Railroad Company; Chapter 267, authorizing the Mayor of the city of Beverly to appoint an underground wires commission with the right to prescribe certain work during the next eleven years; Chapter 290, authorizing the Railroad Commission to regulate the operation of cars of street-railway companies at crossings of industrial railroads; Chapter 293, requiring the names and addresses of the principal officers and directors of gas and electric-light companies to be printed in the annual report of the Gas and Electric Light Commission; Chapter 323, authorizing the Boston & Northern Street Railway Company to purchase the franchise and property of the Old Colony Street Railway Company, subject to terms approved by the Railroad Commission, thus permitting the establishment of a single system of about 1000 miles of track on the north and south sides of Boston; Chapter 345, adding headlights to the jurisdiction of the Railroad Commission over street-railway car equipment, and Chapter 348, relative to the inspection of electric meters. The last provides a nominal change in the wording of the existing law placing the inspection of meters within the board's jurisdiction. Chapter 349 provides that a corporation engaged in manufacturing or selling electricity for lighting, heating or motor service shall not without legislative authority transfer its franchise or lease its works except as provided under jurisdiction of the Gas and Electric Light Commission. Chapter 357 provides for the assent of stockholders when street-railway companies sell their franchises and property or consolidate with other companies and protects the dissenting stockholder by arranging for the appointment of commissioners by the courts to determine the value of dissenting shares on the day that the Railroad Commission approved the sale or consolidation. Chapter 364 provides for placing wires underground in not more than 3 miles of main streets and 2 miles of side streets in Boston yearly. Chapter 371 prohibits the overhead transmission of electricity in Boston at over 5000 volts alternating current or 10,000 volts direct current after June 30, 1913.

The committee on mercantile affairs has recommended to the next Legislature House bill 1277, which provides that any telephone, telegraph or electric-light company owning poles on locations previously granted by the municipal authorities may permit other similar companies to make attachments to such poles without further hearing, provided the approval of the wire inspector is first received. The amended Senate bill 478, confirming the locations of electric lines as desired by the Massachusetts Electric Lighting Association, has been passed to be engrossed in concurrence. The outlook for a bill favorable to the construction of the Boston & Eastern Electric Railroad is brighter than at any previous time in the present session. The committees on street railways and metropolitan affairs, sitting jointly, have named a sub-committee to draft a bill giving the company a certificate of exigency, and also another subcommittee to draw a bill authorizing the New York, New Haven & Hartford Railroad to acquire the Boston, Revere Beach & Lynn Railroad and build a tunnel under Boston Harbor, thus taking the first definite step toward steam-railroad electrification in the Boston district. Governor Foss has signed the bill providing that all gas and electric-service companies using cash-recording meters shall be responsible for the loss

by fire of all cash deposited in such meters. House bill 477, providing for the transmission of electricity for street railways or electric railroads, with the right of appeal to the Gas and Electric Light Commission against the adverse decisions of local authorities upon the company's petition for line locations, has been passed to be engrossed. The bill provides for the joint use of pole lines in certain cases and for the proper labeling of all high-potential circuits. House bill 1340, providing that whenever a gas or electric-light company shall apply to the Gas and Electric Light Commission to issue additional capital stock the board should have the power to make such recommendations relative to the price and quality of the gas and electricity supplied as it may see fit, has been rejected by the Senate by a vote of thirteen to eight. Under the existing law the board fixes rates only upon complaint.

Massachusetts Commission News.

Governor Foss has sent a special message to the Legislature again recommending the establishment of a public-utilities board in place of the present State commission. Considerable surprise has been caused by the fact that in the face of a report advising no change, by Mr. C. H. Scovell, who made an expert inquiry into the telephone supervision and other work of the Massachusetts Highway Commission at the request of the Governor, the executive should still adhere to his stand on behalf of a single commission. There appears to be entire popular satisfaction with the present tribunals and there is practically no prospect of the Governor's attacks being heeded in either branch of the Legislature.

The Massachusetts Gas & Electric Light Commission has issued a decision sustaining the appeal of the Worcester Electric Light Company against an order of the Worcester Board of Aldermen granting Mr. Alfred S. Lowell permission to lay and maintain conduits and mains in Foster Street for the purpose of supplying electric service to his premises. The respondent maintains an isolated plant in Worcester at the intersection of Foster and Norwich Streets and desired to supply service to his store at the intersection of Main and Foster Streets by a diagonal line of conduit about 140 ft. in length, crossing Foster Street in order to fulfil its object.

In its decision the commission points out that the consent of the Board of Aldermen granted the respondent deals with an important question of public policy respecting the supply of electricity in Worcester. The commission has had occasion in earlier decisions to pass upon this matter and has reached the conclusion that its duty is confined to passing upon the question of public policy presented by the appeal, and that it has no power to modify or restrict the terms of the aldermanic order itself. Furthermore, the board's jurisdiction seems to be exhausted by one appeal. If the appeal before the commission should be dismissed, the right of Mr. Lowell to engage generally in the manufacture and sale of electricity in Worcester would be settled conclusively so far as the board is concerned, and he might thereafter sell to anyone within reach of the proposed line and extend his lines wherever and so far as the Board of Aldermen should grant the necessary street locations. The commission does not question the sincerity of Mr. Lowell's assurance that he desires this conduit location for the sole purpose of supplying energy to the corporation in which he is interested, but says: "But the meaning and effect of the order of the Board of Aldermen must be determined by its terms and by the conditions which may surround the exercise of the privileges granted thereby and not by any verbal representations made by Mr. Lowell of his intentions with respect to the matter. In fact, no criticism could justly be made of him should some future change of condition or of business not at present anticipated make it desirable or necessary to modify his purpose and exercise to the full the rights acquired under this order."

The commission further says in part: "The legislative policy with respect to the admission of a new company or person to supply electricity in a territory already served by an existing company, and the board's interpretation and administration of that policy, are well known and were not criticised or doubted by the respondent. The essential consideration is not merely the desire or the personal convenience or interest of the party applying for admission, or of those to whom he proposes to supply energy, or of the existing supply company, but rather the general public interest. An electric light company has no necessary or legal monopoly of the territory which it serves. If it is not properly or adequately performing its public duties a situation arises which may not only justify but require this board to admit a competitor. But with this restriction the prevailing opinion based upon experience has been that the community as a whole will be more adequately and economically served by one company than, in the language of the Supreme Court, by 'as many companies or persons as may be minded to put wires in the streets and try their luck.'

"In this case it was not contended that the Worcester Electric Light Company is not properly and adequately performing its public duties. It is true that the respondent had a grievance against the company, but this was found to have arisen out of a mistake and was promptly remedied. But it was urged that the order of the Board of Aldermen is so restrictive in its terms as to confine the use of the proposed line exclusively to the use of the A. S. Lowell Company and that therefore the order should be affirmed. A careful examination of the order fails to give substantial support to such a construction of its terms. While the position of Mr. Lowell is quoted in the order in full and sets forth specifically his purpose, the order permits the laying of a conduit and wires between the two buildings mentioned 'for the purpose of supplying light, heat and power.' It restricts the use of the privilege to the petitioner himself, but this is a restriction commonly imposed in locations granted to electric light companies, and for that matter is probably merely declaratory of the law relative to the privilege given. The order plainly does not authorize the construction of a line 'for private use,' for in that event the line upon construction would become the property of the city by operation of law; whereas this order expressly provides that it shall be forfeited to the city only upon breach of a condition of the grant. Even if the order were capable of the interpretation urged there is serious reason to doubt whether the Board of Aldermen may grant a location for a line not for private use with a valid condition that no electricity shall be distributed thereunder save to certain designated persons or corporations. It must be kept in mind that the law by which the rights of all concerned are to be determined makes the A. S. Lowell Company and Mr. Lowell, whatever his interests therein, two entirely distinct persons. In spite of the seeming identity of interest the case under discussion is not one where an individual or corporation owning a lighting plant has extended the quarters necessary for the accommodation of his or its business by purchasing or hiring a building separated by a public street from premises already occupied. There are statutes which expressly provide for permits for private use, but they are clearly inapplicable to this case." The appeal was therefore sustained and the decision and order of the Board of Aldermen annulled.

The board has issued an order authorizing the issue by the Pittsfied Electric Company of additional capital stock of the par value of $225,000 to meet the cost of additions to plant, covering mainly the building of a steam turbine station at Silver Lake and its articulation with the company's existing system of generation and distribution. The stock is to be offered to the stockholders at a price of $135 per share as determined by the board of directors.

New York Commission News.

The New York Public Service Commission, Second District, has authorized the Port Jefferson Electric Light & Power Company to issue bonds to the aggregate amount of $30,000 with interest at 5 per cent payable semi-annually. The proceeds of the bonds are to be used for the purchase of new

apparatus amounting to $8,800, for expenses incurred in improving its plant, $2,700, and for the payment of bills and accounts incurred for capital purposes, $18,500. The company is required to make entries on its books which will properly take care of the replacements of apparatus and material which have taken place and the improvements being made to the plant and distribution system.

The commission has authorized the Delaware County Electric Light & Power Company to execute a mortgage upon all its property to secure an issue of $200,000 par value 5 per cent twenty-year gold bonds. The company is authorized at the present time to issue and sell $25,000 of these bonds at not less than par. The company is given permission to issue and sell 100 shares of its common capital stock at a par value of $100 per share. Of the proceeds of the $25,000 of bonds and $10,000 of stock the sum of $2,000 is to be set aside for the purchase of additional electrical equipment, $1,500 is to be reserved for an extension line to the county house, and the balance of the sum is to be used for rebuilding and putting in proper shape for operation the plant and distribution system formerly owned by the Delhi Electric Company situated at Delhi, Delaware County.

Because the New York Telephone Company refused to install a pay station telephone in the store of McManus Brothers, New York City, they have complained to the commission, asking that an order be entered directing the telephone company to provide this service. The complainants allege that without this facility they are at a disadvantage with their competitors who have pay stations installed. When refusing the request of the complainants the New York Telephone Company stated that the locality in question is amply supplied with pay stations. The New York Telephone Company has been served with a copy of the complaint and an answer is required to be filed with the Public Service Commission of the Second District within twenty days.

The commission has authorized the Northern Wayne Electric Light & Power Company to purchase the franchises, works and system of the Wolcott Electric Light & Power Company in the village of Wolcott for the sum of $33,000. The company is also authorized to begin and complete the construction of a pole line and equipment for the transmission of electricity from the substation of the Rochester & Sodus Bay Railroad Company at Sodus in the village of Wolcott and through the towns of Rose, Huron and Wolcott to the village of Red Creek, and from the village of North Rose to Rose, and the construction of secondary distribution systems in the villages of North Rose, Rose and Red Creek, all in the county of Wayne. The company is also authorized to issue its capital stock to the par value of $75,000, the proceeds to be applied for the purchase of the Wolcott plant and the necessary construction of the lines authorized under its various franchises.

The Plattsburgh Gas & Electric Company has been authorized to issue its thirty-year 5 per cent bonds to the amount of $10,000, the bonds to be sold at not less than 92. The proceeds of the bonds are to be used for extensions and improvements of its plant.

The commission has closed upon its records the complaint of the Lycoming & New Haven Telephone Company against the New York Telephone Company. As a result of the hearing had on the application the New York company entirely receded from the position that the complainant should secure the consent of certain persons operating a competing line before it would enter into a working agreement with the Lycoming company, and now offers the Lycoming company exactly the same agreement for joint service that it is working under with five other local companies in that section, some of which have a greater number of subscribers than the Lycoming company has.

The commission does not agree with the complainant that the switch connection of $6 per subscriber should be reduced to $3, and says that if the complainant's subscribers should greatly increase in number an entirely different situation would be presented.

AMERICAN ELECTRICAL ENGINEERS—XXXIV.

M. W. Buchanan.

Myron Webster Buchanan was born June 4, 1878, at Frankfort, Herkimer County, New York, and received his early education at the Sauquoit Academy, Sauquoit, N. Y. After preparation at the high schools of Bennington, Vt., and Clayville, Oneida County, N. Y., he entered Cornell University, from which he was graduated in 1900 with the degree of M.E. in electrical engineering.

Having been associated with graduates of two preceding classes who had been engaged to complete the organization of an electrical laboratory at the United States navy yard, New York, for the purpose of experimental and inspection work in connection with electrical machinery and supplies, of which the navy had become a considerable purchaser, Mr. Buchanan accepted a position in the laboratory immediately upon graduation in 1900. During the following two years experience of an interesting character was gained relating to almost every kind of electrical apparatus used by the navy at that time, both

M. W. Buchanan.

in the laboratory and after installation on board the vessels. Acceptance and competitive tests of an extensive nature were conducted upon such apparatus as searchlights of domestic and foreign manufacture, incandescent lamps, rubber-insulated wire and cable, batteries, interior-communication accessories, motors and generating sets. At the time of leaving the New York navy yard Mr. Buchanan was in charge of the test of engine-driven generating sets. The popular sizes of ships' generators at that period were 16 kw, 24 kw and 32 kw. As the size of vessels and the demand for more light and electrically operated auxiliary machinery increased, engine-driven generators were increased to 50 kw, then 100 kw, and the demands for space economy were later met by the adoption of the 300-kw turbo-generator, which has been the unit of the generating stations of recent battleships.

After a competitive examination, Mr. Buchanan was in 1902 appointed expert electrical aid in the office of the superintending naval constructor at the Union Iron Works, San Francisco. This assignment was especially desirable, inasmuch as this was the only shipbuilding plant contracting for United States naval vessels which designed and built the greater por-

tion of the engines, generators and motors and a considerable part of the minor electrical equipment installed. The duties of the electrical aid extended from the design office to the acceptance tests after installation on shipboard, and required the preparation in book form for each vessel of a complete description with data of design and performance, covering all electrical apparatus under the cognizance of the office. This work also involved some sea duty, the trials of new vessels being held off Santa Barbara, Cal., about a day's voyage south from the Golden Gate. During Mr. Buchanan's term of duty at the Union Iron Works the following vessels were under construction there for the navy: Battleship, *Ohio;* cruisers, *Tacoma, Milwaukee, California* and *South Dakota;* monitor, *Wyoming;* torpedo boat destroyers, *Paul Jones, Perry* and *Preble;* submarines, *Grampus* and *Pike.* The Union Iron Works was a heavy sufferer from the earthquake of 1906 and considerable time elapsed before work could be resumed on the naval vessels. During this period Mr. Buchanan devoted a portion of his spare time to consulting work of a minor character.

In 1907 Mr. Buchanan was transferred to the Navy Department, Washington, D. C., to fill a vacancy in the position of assistant electrical expert to the Bureau of Construction and Repair, and later in the same year, after a competitive examination, was appointed expert electrical aid to that bureau, which position he has since occupied. In this position Mr. Buchanan has been closely in touch with the relations existing between the Navy Department and the contractors and manufacturers who do business with the government. He has actively engaged in the preparation of uniform electrical specifications for the different branches of the Navy Department, with the co-operation of the manufacturers. As a result, specifications for electric motors and controlling appliances for all purposes on shore and on board naval vessels have been developed by the various bureaus of the Navy Department in conference with the manufacturers and have been issued by the Secretary of the Navy for the use of all branches of the department. This work may be said to have been promptly accomplished when the great inertia of the naval organization and the resistance which radical changes in naval practice usually encounter are considered. Mr. Buchanan's personal views on this subject are contained in a discussion on the subject of government specifications for electrical apparatus, printed in the *Professional Memoirs* of the Corps of Engineers, U. S. A., January, 1911.

In connection with his work under the Bureau of Construction and Repair, Mr. Buchanan has been called upon to investigate and report upon a number of subjects, notably electrolysis on shipboard, the capacity of fans for ships' ventilation systems, application of electric heating to vessels, method of obtaining thermometer temperatures of electrical machinery on test, alternating and direct-current electrical equipments for navy yard machinery, especially cranes, and the extension of electric drive to certain of the remaining steam-driven ship auxiliaries.

Mr. Buchanan is a member of the American Institute of Electrical Engineers and of the executive committee of the Washington Section of the Institute.

Since the above sketch was written Mr. Buchanan has resigned from the naval service to enter the engineering department of the Diehl Manufacturing Company, of Elizabethport, N. Y., which concern has during the past two years done much naval and other governmental electrical work.

CURRENT NEWS AND NOTES.

Large High-Pressure Gas Plant.—Contracts have been let for the construction at Lockport, north of Joliet, of a 3,000,000-cu. ft. high-pressure gas plant to supply gas to forty-five cities and towns in northern Illinois.

Philadelphia-New York Wireless Telegraphy.—Overland wireless telegraphy between Philadelphia and New York was placed in commercial service on May 20. The stations are located on the Wanamaker stores in the two places and will be operated as a part of the system of the Marconi Wireless Telegraph Company.

Merchants' Parade in Celebration of Street Lighting.—Thursday, May 25, was set aside by the Business Men's Club of Grand Crossing, a suburb of Chicago, for the celebration of the new installation of tungsten street lighting in the business section. In the evening a parade was held along the brilliantly lighted streets.

Metallic Titanium.—The first publication of the "Engineering and Science Series" of Rensselaer Polytechnic Institute is a paper by Mr. Mathew A. Hunter on "Metallic Titanium." The paper, together with an appendix by Mr. Hunter and Mr. E. C. Jones, gives a thorough account of the properties of this metal and the processes for its reduction.

Michigan Student Inspection Trip.—The senior engineers of the Michigan Agricultural College to the number of forty, accompanied by the heads of the departments of mechanical, electrical and civil engineering, recently made an inspection trip of four days visiting the Pittsburgh district, Buffalo and Niagara Falls. They left Lansing on a special car Tuesday night, May 9.

State Aid for M. I. T.—In order to provide money for a new site the Massachusetts Institute of Technology has been granted by the State $100,000 annually for ten years in return for which the institute binds itself to maintain eighty free scholarships to be apportioned among the forty senatorial districts of the State. The institute is pledged to ask no further aid from the State after the $1,000,000 has been received.

Electrolytic Survey in Denver.—The Denver Union Water Company has just completed an exhaustive electrolytic survey under the direction of Mr. A. M. Ballou, formerly electrical engineer with the Denver City Tramway Company. The tests were unusually elaborate in number and method. Maps have been completed for all districts together with general map showing current distribution, with return feeder arrangements, quantity of current carried by water mains, positive and negative districts for water mains, etc.

Chicago Section, Illuminating Engineering Society.—At the next meeting of the Chicago Section of the Illuminating Engineering Society to be held Thursday noon, June 15, Mr. W. R. Bradley, of the American Luxfer Prism Company, will present a paper on "Daylight Illumination." At the same meeting the nominating committee, comprising Messrs. Francis A. Vaughn, Oliver Hogue, James R. Cravath, George C. Keech and Charles A. Luther, will present its report proposing officers for the Chicago Section during the ensuing year.

Electricity Versus Gas in Boston Street Lighting.—Commissioner Louis K. Rourke of the Boston Public Works Department is formulating plans for the extension of electric street-lighting service into various districts now lighted by gas lamps, anticipating the authorization by the City Council of the purchase of gas-lighting equipment. Mr. Rourke proposes to install 2000 tungsten lamps of 60-cp rating in the section between Roxbury Crossing, Dorchester and Dorchester Bay, reducing the number of gas lamps in service to 9500. The city will save $1.27 per lamp per year by adopting electricity, the price charged by the Edison Electric Illuminating Company for the tungsten-lamp service being $22.31 per year each. The city is considering investing about $280,000 in existing gas equipment and undertaking the municipal operation of the apparatus. If the city does its own gas lighting, automatic lighting and extinguishing devices will be installed, and about 120 lamp lighters will be relieved of duty. It is expected that the adoption of electricity in a section as large as that indicated in Mr. Rourke's plans will conclusively demonstrate the superiority of the tungsten lamp for the service.

Big Dam for California.—An unofficial statement from San Francisco is to the effect that the Great Western Power Company is to build a dam and reservoir at Big Meadows, Cal., which will surpass in capacity both the Roosevelt dam and project in Arizona and the Assouan dam in Egypt. Sufficient water will be stored to irrigate 300,0000 acres.

American Museum of Safety.—The American Museum of Safety has been granted a special charter by the New York State Legislature, thus putting it in the same class with the Metropolitan Museum of Art and the New York Museum of Natural History. The exhibits in the museum rooms in the Engineering Societies Building, 29 West Thirty-ninth Street, now include practical devices for safeguarding human life in almost every field of labor.

W. P. I. Dinner in Pittsburgh.—The graduates of the Worcester Polytechnic Institute who will attend the spring meeting of the American Society of Mechanical Engineers in Pittsburgh will dine together informally at the Fort Pitt Hotel, Pittsburgh, on Monday, May 29, at 7:30 p. m. Mr. R. J. Dearborn, secretary of the Pittsburgh W. P. I. Alumni Association, 745 Hill Avenue, Wilkinsburg, Pa., is in charge of the arrangements.

Chicago Electric Club.—Mr. Thomas I. Stacey, secretary of the Electric Appliance Company of Chicago, entertained the members of the Chicago Electric Club, following its weekly luncheon, Wednesday noon, May 17, with an account of his recent trip to the Panama Canal. Mr. Stacey spoke interestingly and appreciatively of the work being accomplished by American engineers in the Canal Zone, and with the aid of a stereopticon lantern exhibited a number of photographs which he took on the Isthmus.

Meeting of Automobile Engineers.—The Society of Automobile Engineers will hold its annual meeting on June 15 at the Algonquin Hotel, Dayton, Ohio. Among the papers to be presented will be one by Mr. Justus B. Entz entitled "The Question of Long Versus Short Stroke Motors." An important part of the proceedings of the meeting will be the consideration of reports by the general standardization committee, which includes in its membership about eighty of the leading automobile engineers of the country, covering every branch connected with motor-car production.

Water Turbine Efficiency.—The May number of the *Armour Engineer* contains a paper by Mr. Stanley Dean, instructor in civil engineering at Armour Institute, which gives the methods and results of a test of two 5000-hp hydroelectric units installed in the plant of the Schaghticoke Hydroelectric Development Company on the Hoosac River at Schaghticoke, 22 miles east of Schenectady, N. Y. The turbines are of the Pelton-Francis type, direct-connected to 3000-kw alternators, and designed to develop 5000 hp at 300 r.p.m. under a head of 146 ft. The efficiencies at various loads were as follows: 0.53 load, 82 per cent; 0.77 load, 86 per cent; 0.86 load, 85 per cent; 1.02 load, 82.9 per cent. The generator efficiency at these several loads was 95.1 per cent, 96.4 per cent, 96.6 per cent and 96.5 per cent respectively.

Election of Delegates from Commonwealth Edison Branch, N. E. L. A.—After an exciting letter-ballot election the Commonwealth Branch of the National Electric Light Association has elected six delegates to the New York convention of the association to be held on May 29-June 3. The successful ones are Mr. E. W. Goedjen, contract department; Mr. Otto Hanf, treasury department; Mr. J. H. Perry, meter department; Mr. D. H. Nichols, construction department; Mr. J. C. Johnson, Quarry Street station; Mr. J. Aldred, Fisk Street station. The Commonwealth Edison Company defrays all the expenses of these delegates and will have in addition a large delegation of company representatives. The membership list was divided into three divisions and each division elected two delegates. This was to secure a balanced representation. Valid votes to the number of 614 were cast. Members behind in their dues were not allowed to vote, and all defective ballots were thrown out.

Annual Meeting of the Philadelphia Electric Company Section, N. E. L. A.—The annual meeting of the Philadelphia Electric Company Section of the National Electric Light Association was held May 15 and was given over to the election of officers and the chairman's annual report. The latter consisted of a review of the work of the year and a summary of the reports of the various committees. The following officers were elected: Chairman, Mr. Thomas Sproule; vice-chairman, Mr. R. B. MacCreery; secretary, Mr. B. Frank Day. The executive committee comprises the following: Two-year term, Messrs. J. T. Maxwell, J. D. Israel, C. J. Russell and Joseph B. Seaman; one-year term, Messrs. George Ross Green, P. H. Bartlett, A. H. Manwaring and A. R. Granger. The treasurer and three members of the executive committee are to be appointed by the president of the Philadelphia Electric Company. An amendment to the constitution was adopted providing for the appointment of two honorary members to the executive committee. The attendance was 116.

Two-Phase to Three-Phase Transformation.—Due to an error in editorial transcription, there appears in the *Electrical World* of May 11, on page 1167, a statement relative to a certain voltage ratio which is not directly applicable to the diagram of connections referred to. The statement that the two-phase voltages are not equal in value to the three-phase voltages is true of the terminal voltages of the transformers, which, however, are not utilized in the connection illustrated. The fact is that with the arrangement shown in Fig. 2 the three-phase voltages are exactly equal to the two-phase voltages. Moreover, they are obtained directly from three of the four busbars or distributing lines of the two-phase system. Three-phase voltages of 115.5 per cent of the two-phase value may be obtained from the terminal transformer connection; it is to this inconvenient ratio of 1.00 to 1.155 that the statement mentioned above is applicable. The author of the article in question, Mr. F. T. Wyman, in bringing this error to our attention points out that the scheme described is used in numerous installations throughout the United States, 1800 kw of transformers being thus operated in Altoona, Pa.

A. I. E. E. Electrical Show.—The A. I. E. E. student branch of Ohio State University gave an electrical show May 12-13 in the laboratory of the Department of Electrical Engineering of the university. The exhibits were of two general types, those entirely due to the students, which in general related to special uses of electricity not commonly known, and a group of commercial exhibits supplied by manufacturing and commercial companies. All of the apparatus on exhibition was shown in operation. The exhibit of telephone apparatus was very complete. The cooking apparatus on exhibition was operated by students of the department of domestic science, and a coal-mining electrically driven coal cutter and drill were installed in a covered pit, arranged to represent a coal mine. During the exhibition demonstrations were given of the operation of various devices and processes, including the alternating-current rectifier, high-tension transformer, photometers, electric welding, wireless telegraphy, the talking arc, a wireless control arrangement, Geissler tubes, etc. The exhibits in illumination, both interior and exterior, were very complete. The only accident occurred during the exhibition of Geissler tubes in a dark room. The frequency of the spark from the induction coil was such that the fan in the room seemed to be running backward very slowly and a visitor attempted to stop the fan with his finger.

ELECTRICITY IN NEW YORK CITY

FEATURES AND STATISTICS OF THE GENERATING STATIONS OPERATED BY THE PUBLIC SERVICE CORPORATIONS.

NEW YORK CITY is made up of five boroughs, namely, Manhattan, with a population of 2,331,542; Brooklyn, with a population of 1,634,351; Bronx, with a total of 430,980 souls; Queens, with 284,041, and Richmond, with 85,969. The greater city has therefore a total population of 4,766,883. All of the public utilities in the city with the exception of the telephone and telegraph conduct their business under the supervision of the Public Service Commission, First District, State of New York. The following public-service corporations operate electric generating stations in the city; New York Edison Company, Edison Electric Illuminating Company of Brooklyn, New York & Queens Electric Light & Power Company, Bowery Bay Electric Light & Power Company, Bronx Gas & Electric Company, Queens Borough Gas & Electric Company, Flatbush Gas Company, Interborough Rapid Transit Company, Metropolitan Street Railway Company, Coney Island & Brooklyn Railroad Company, Transit Development Company, Third Avenue Railroad Company, Richmond Light & Railroad Company, Staten Island Midland Railway Company, New York Central Railroad and the Pennsylvania Tunnel & Terminal Railroad Company. The amount of energy generated by these companies last year approximated 1,750,000,000 kw-hours. There are of course other companies using electricity in New York City which is generated outside the city; but these are not included in the estimate above given.

It is not the purpose here to describe the various stations in detail, but to point out their chief characteristics and give some statistics regarding them. For the benefit of delegates attending the convention of the National Electric Light Association, the features of the New York Edison Company are stated at greater length in the present article than those of the other companies, because the article on this company published elsewhere in this issue is devoted to the rebuilding of one of its stations. The systems of the other two large distributing companies are described in separate articles so that mere references are necessary here.

Owing to the clear skies ever present in New York one is not usually impressed with its industrial greatness. Not only is it the metropolis of the Western Hemisphere, but it is the Electrical City of the World; for there is more electric power within its confines than in any other place on earth. All of the electricity used is generated in steam-driven stations, the record for greatest efficiency being held by the Fifty-ninth Street station of the Interborough Rapid Transit Company, where a kw-hour is generated from 2 lb. of coal. The latter is not a test figure but is obtained by dividing the monthly output of the station in kw-hours by the pounds of coal burned.

NEW YORK EDISON COMPANY.

The New York Edison Company operates four generating stations. Two main stations adjoin each other at East Thirty-eighth, Thirty-ninth and Fortieth Streets, First Avenue and the East River and are known as Waterside Stations No. 1 and No. 2. So far as operation is concerned both might be considered as parts of a single station and that the largest in the world. The other two stations are located, one at 55 Duane Street and the other at 149th Street and Ryder Avenue, Bor-

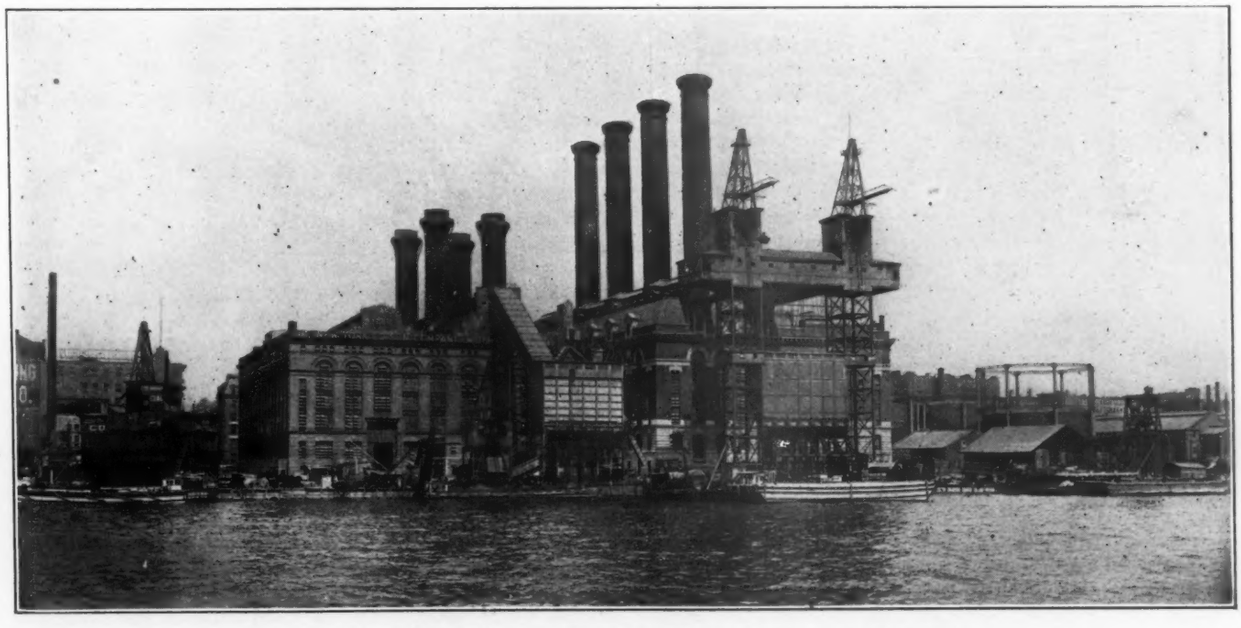


Fig. 1—Waterside Stations of New York Edison Company on East River.

ough of the Bronx. The combined equipment of the two last mentioned is 10,800 kw, whereas the combined capacity of the two Waterside stations is approximately 250,000 kw; No. 1

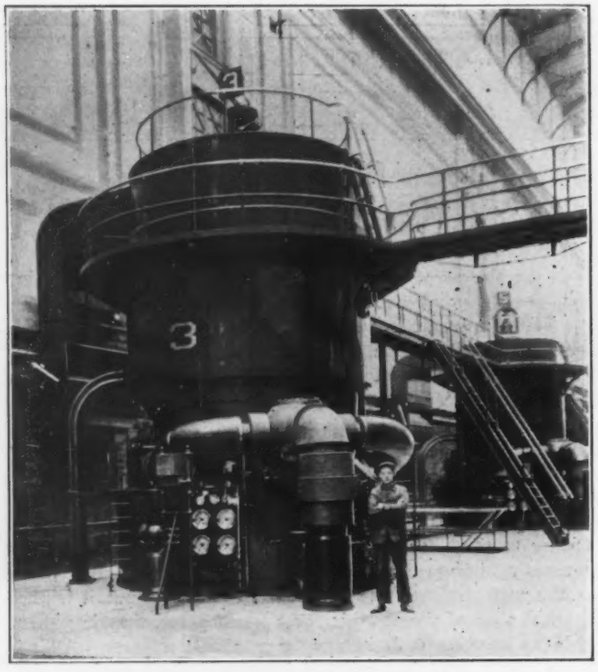


Fig. 2—Turbines in Waterside Station No. 2.

when complete having a maximum rating of 129,500 kw and No. 2 having a maximum rating of 120,000 kw.

Waterside Station No. 1 was completely described in these pages in January, 1902. The station is at present undergoing extensive changes, a complete account of which is published elsewhere in this issue. The station when changed will contain fifty-four Babcock & Wilcox boilers rated at 650 hp at a work-

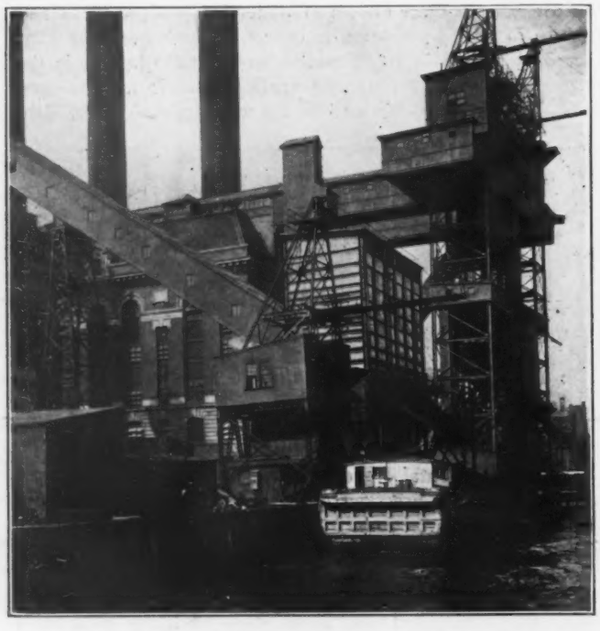


Fig. 3—Coal Conveyors at Waterside Stations.

ing pressure of 200 lb. Twenty of the furnaces will be equipped with Taylor stokers and thirty-four have flat grates and are hand-fired. Semi-bituminous fuel will be used in the furnaces of the boilers equipped with stokers, whereas the others are hand fired with a mixture of No. 3 buckwheat and bituminous coal. There are seven 5500-hp vertical, three-cylinder, compound condensing Westinghouse engines direct-connected to as many 3500-kw, 25-cycle, three-phase, 6600-volt

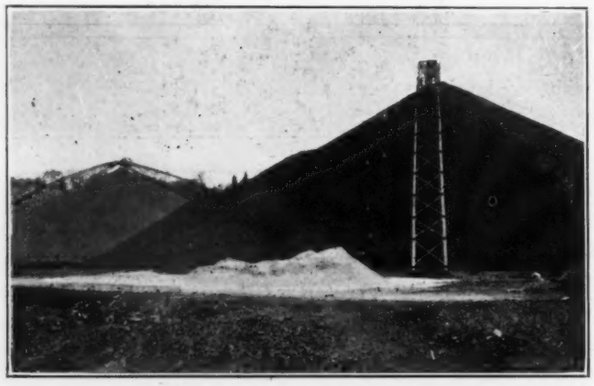


Fig. 4—Coal Storage of New York Edison Company.

General Electric alternators; two 10,000-kw and one 5000-kw, 25-cycle Curtis units and one 5000-kw and one 9000-kw, 60-cycle Curtis units at present in operation. Three 20,000-kw, 25-cycle Curtis units are now in course of erection. All of the auxiliary apparatus is steam-driven and the maximum load carried by the station last year was 68,800 kw.

Waterside Station No. 2 was completed in 1909 and described in detail in these columns March 4, March 11, March 25 and April 8, 1909. In this station the operating room is on the north side of the building, the boiler house being on the south side to facilitate tying the steam end of the plant to the boiler plant of Waterside Station No. 1, which lies across the street to the south and in which the arrangement is reversed,

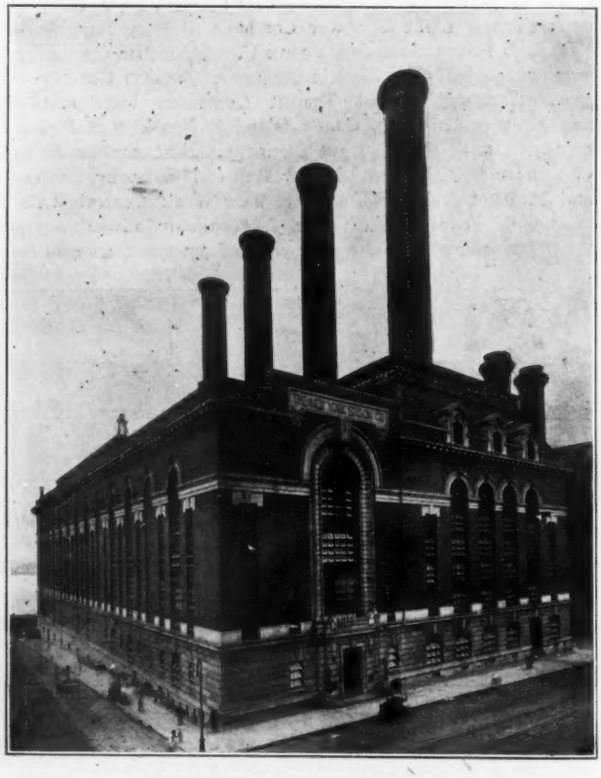


Fig. 5—Waterside Station No. 2.

the boiler house being to the north and the generator room to the south. The operating room contains two horizontal turbines and eight vertical turbines arranged in parallel rows with an aisle in the center. The electrical galleries are arranged along the north wall and under them on the main floor are the

exciters and motor-generators. In a vault under the sidewalk on this side of the station is the storage battery. The auxiliary apparatus for the turbines is located in the basement under the generating room and the electrical control board occupies the west end of the operating room. The board is semi-circular in shape and the arrangement is such that the switchboard operator has an unobstructed view of the operating floor.

The boiler house contains ninety-six Babcock & Wilcox boilers rated at 650 hp, 200 lb. working pressure and 125 deg. superheat. Thirty-six of the boilers are fitted with flat grates and are hand-fired while the remainder are fitted with Taylor stokers, forty-eight of which are at present being installed. Semi-bituminous coal is burned in the boilers fitted with stokers and a mixture of No. 3 buckwheat and bituminous in the hand-fired boilers. The boilers are installed in eight rows

aggregate maximum rating of the generators is 120,000 kw and the peak load carried in 1910 was 83,400 kw. Surface condensers utilizing salt water from the river are fitted to all of the turbines.

The three high-tension cables from the armatures of each of the generators are led through vitrified ducts under the floor to similar ducts on the north division wall leading to the main oil switches, located on the fourth mezzanine floor of the electrical galleries. The feeder oil switches are also located on the fourth mezzanine floor. From these switches are run the outgoing high-tension triplex feeder cables of the distributing system. The third mezzanine is given up to transformer compartments, the second to the selector switches and the first to the high-tension main and auxiliary buses. All of these switches are of the remote-control type and are operated from

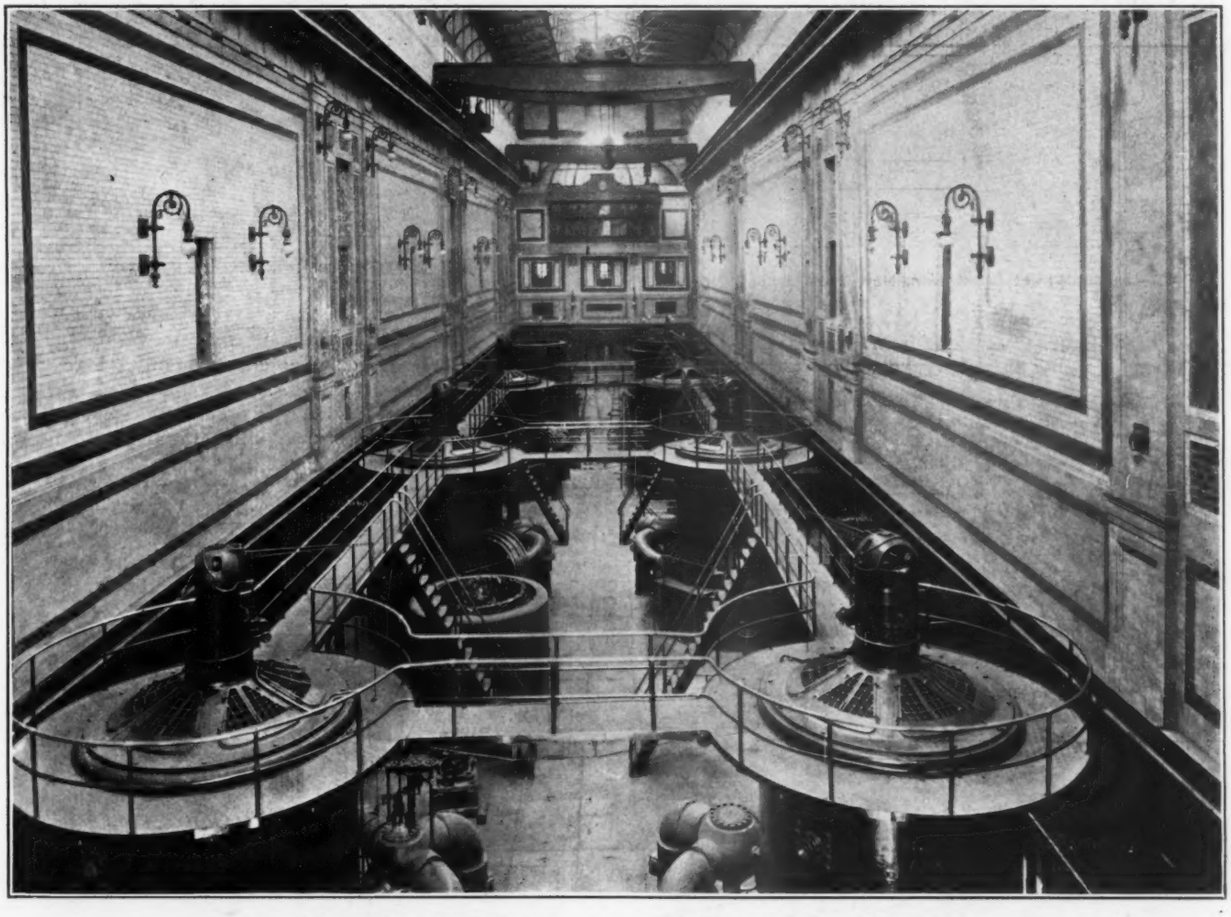


Fig. 6—Waterside Station No. 2 of the New York Edison Company.

across the boiler house, six boilers in a row, and two floors are occupied. Four stacks are provided, each serving twelve boilers on each floor or twenty-four in all. The coal bunkers occupy the top of the boiler house and the fuel is delivered to the firing floor in chutes. The fuel is hoisted from barges moored at the dock by two 1.5-ton clam-shell buckets, operated by hoisting and trolley engines in twin steel towers. A cable system of cars distributes the coal to the respective bunkers. Ashes are dumped from the pits into cars in the basement of the boiler-room and drawn by an electric locomotive to a pocket on the bulkhead whence they are conveyed into an overhead ash pocket and chuted to scows for final disposal.

The turbine room, a view of which is given in Fig. 6, contains six 8000-kw Curtis, one 14,000-kw Curtis and two 8000-kw Westinghouse 25-cycle, 6600-volt, three-phase machines and two 8000-kw Westinghouse and one 14,000-kw Curtis 7500-volt, 60-cycle, three-phase machines. Each of the Westinghouse turbines drives a 25-cycle, 6600-volt and a 60-cycle, 7500-volt alternator, the twin generators running at 750 r.p.m. The

the switchboard gallery at the west end of the operating room.

From the generating station the energy is distributed in underground cables to substations in various parts of the city. The substations are very substantial buildings as the engravings indicate and contain six-phase synchronous converters of either the horizontal or vertical type yielding direct current at 270 volts. The direct-current switchboards are divided into two independent sections for the positive and negative poles. The low-tension feeder panels are grouped into a positive and negative board, each of which is provided with three sets of busbars mounted on the back of the panel. Each panel has four feeder switches and above each feeder is mounted an edgewise ammeter. The feeder neutrals are not brought to the operating board but are connected to the storage battery and compensator neutral bus. Storage batteries are installed in all stations to insure continuity of service.

The company maintains several branch offices, the largest of which is at 424 Broadway. From the viewpoint of beauty and interior lighting the Harlem office on 125th Street shown in

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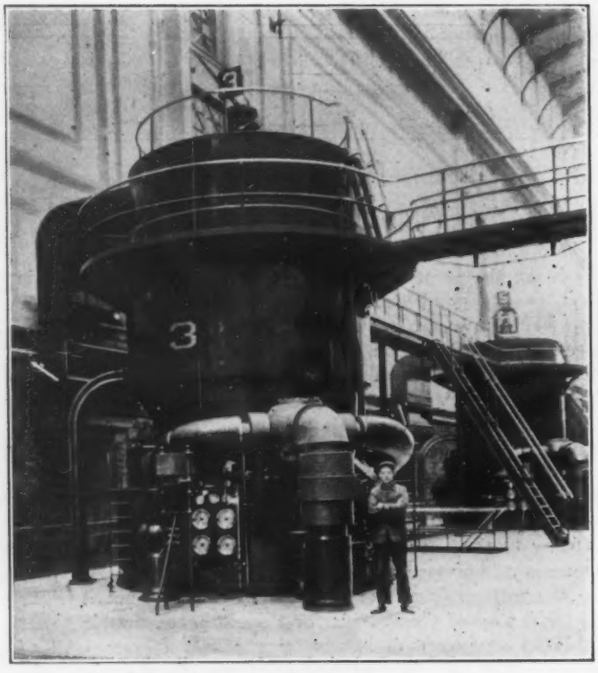

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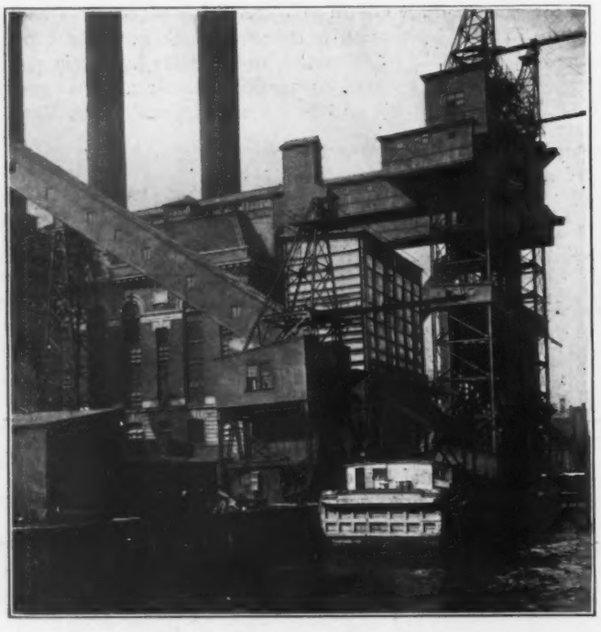

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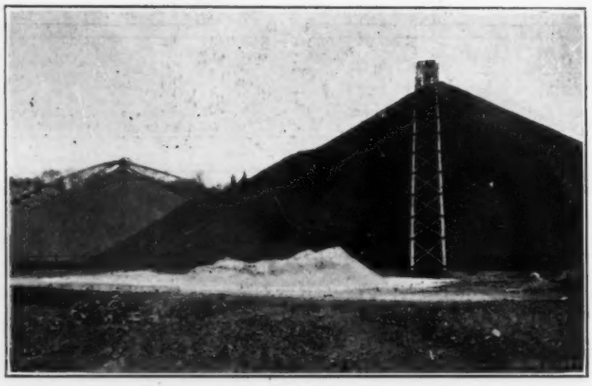


Fig. 4—Coal Storage of New York Edison Company.

General Electric alternators; two 10,000-kw and one 5000-kw, 25-cycle Curtis units and one 5000-kw and one 9000-kw, 60-cycle Curtis units at present in operation. Three 20,000-kw, 25-cycle Curtis units are now in course of erection. All of the auxiliary apparatus is steam-driven and the maximum load carried by the station last year was 68,800 kw.

Waterside Station No. 2 was completed in 1909 and described in detail in these columns March 4, March 11, March 25 and April 8, 1909. In this station the operating room is on the north side of the building, the boiler house being on the south side to facilitate tying the steam end of the plant to the boiler plant of Waterside Station No. 1, which lies across the street to the south and in which the arrangement is reversed,

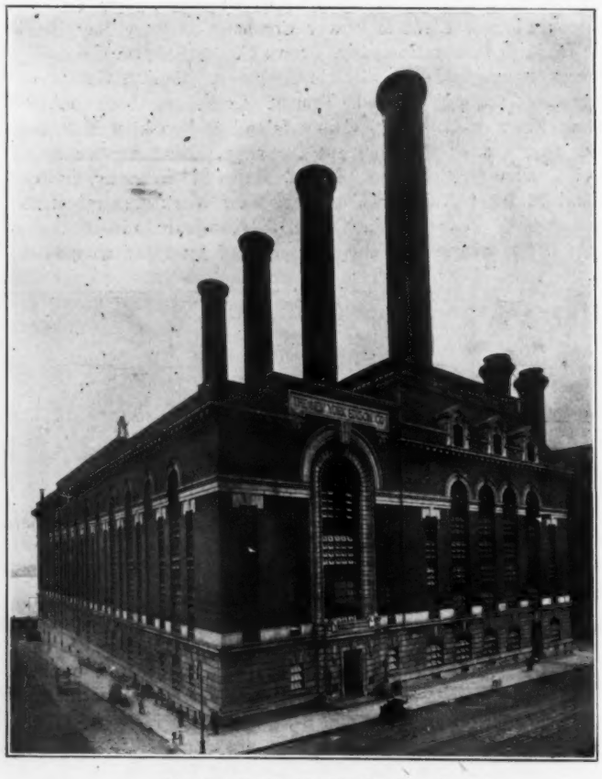


Fig. 5—Waterside Station No. 2.

the boiler house being to the north and the generator room to the south. The operating room contains two horizontal turbines and eight vertical turbines arranged in parallel rows with an aisle in the center. The electrical galleries are arranged along the north wall and under them on the main floor are the

exciters and motor-generators. In a vault under the sidewalk on this side of the station is the storage battery. The auxiliary apparatus for the turbines is located in the basement under the generating room and the electrical control board occupies the west end of the operating room. The board is semi-circular in shape and the arrangement is such that the switchboard operator has an unobstructed view of the operating floor.

The boiler house contains ninety-six Babcock & Wilcox boilers rated at 650 hp, 200 lb. working pressure and 125 deg. superheat. Thirty-six of the boilers are fitted with flat grates and are hand-fired while the remainder are fitted with Taylor stokers, forty-eight of which are at present being installed. Semi-bituminous coal is burned in the boilers fitted with stokers and a mixture of No. 3 buckwheat and bituminous in the hand-fired boilers. The boilers are installed in eight rows

aggregate maximum rating of the generators is 120,000 kw and the peak load carried in 1910 was 83,400 kw. Surface condensers utilizing salt water from the river are fitted to all of the turbines.

The three high-tension cables from the armatures of each of the generators are led through vitrified ducts under the floor to similar ducts on the north division wall leading to the main oil switches, located on the fourth mezzanine floor of the electrical galleries. The feeder oil switches are also located on the fourth mezzanine floor. From these switches are run the outgoing high-tension triplex feeder cables of the distributing system. The third mezzanine is given up to transformer compartments, the second to the selector switches and the first to the high-tension main and auxiliary buses. All of these switches are of the remote-control type and are operated from

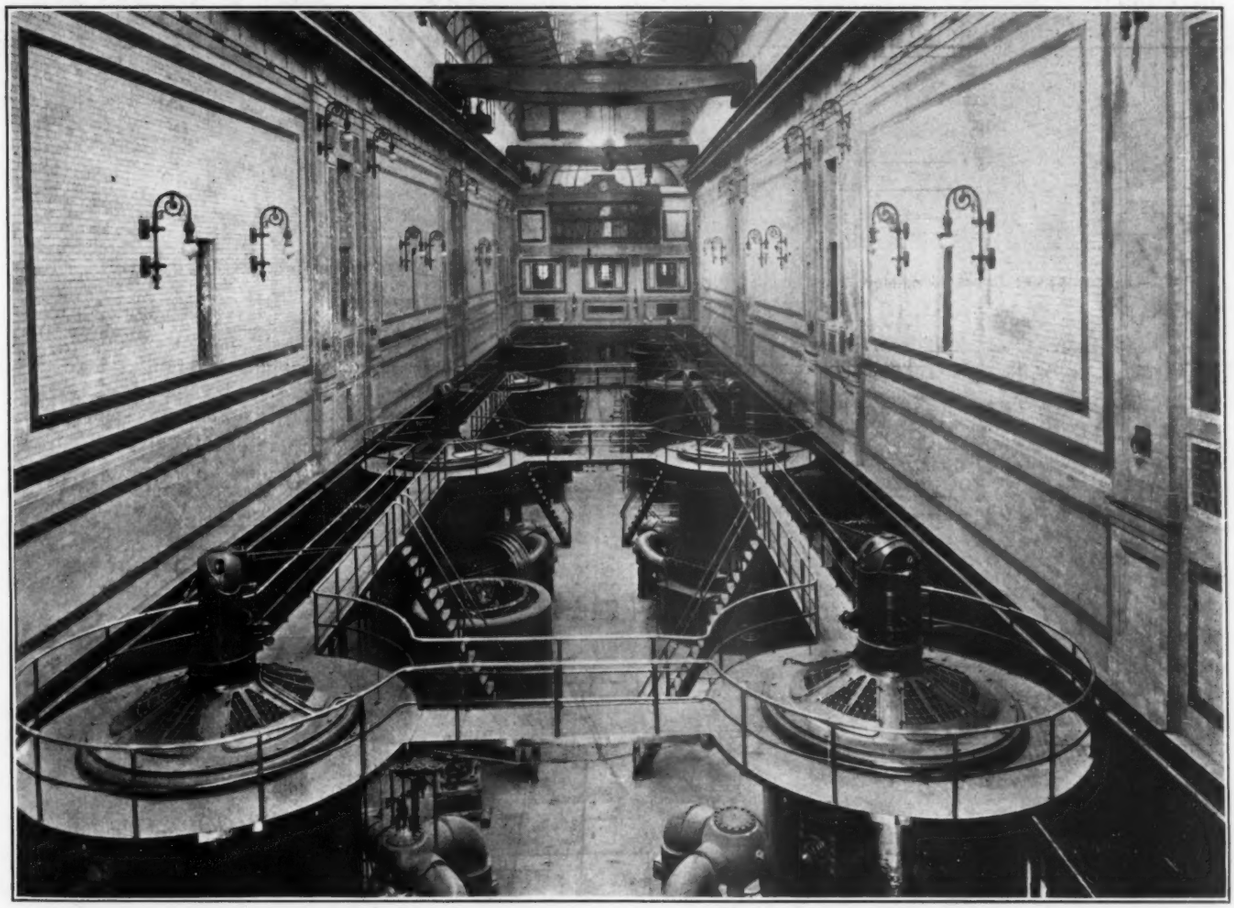


Fig. 6—Waterside Station No. 2 of the New York Edison Company.

across the boiler house, six boilers in a row, and two floors are occupied. Four stacks are provided, each serving twelve boilers on each floor or twenty-four in all. The coal bunkers occupy the top of the boiler house and the fuel is delivered to the firing floor in chutes. The fuel is hoisted from barges moored at the dock by two 1.5-ton clam-shell buckets, operated by hoisting and trolley engines in twin steel towers. A cable system of cars distributes the coal to the respective bunkers. Ashes are dumped from the pits into cars in the basement of the boiler-room and drawn by an electric locomotive to a pocket on the bulkhead whence they are conveyed into an overhead ash pocket and chuted to scows for final disposal.

The turbine room, a view of which is given in Fig. 6, contains six 8000-kw Curtis, one 14,000-kw Curtis and two 8000-kw Westinghouse 25-cycle, 6600-volt, three-phase machines and two 8000-kw Westinghouse and one 14,000-kw Curtis 7500-volt, 60-cycle, three-phase machines. Each of the Westinghouse turbines drives a 25-cycle, 6600-volt and a 60-cycle, 7500-volt alternator, the twin generators running at 750 r.p.m. The

the switchboard gallery at the west end of the operating room.

From the generating station the energy is distributed in underground cables to substations in various parts of the city. The substations are very substantial buildings as the engravings indicate and contain six-phase synchronous converters of either the horizontal or vertical type yielding direct current at 270 volts. The direct-current switchboards are divided into two independent sections for the positive and negative poles. The low-tension feeder panels are grouped into a positive and negative board, each of which is provided with three sets of busbars mounted on the back of the panel. Each panel has four feeder switches and above each feeder is mounted an edgewise ammeter. The feeder neutrals are not brought to the operating board but are connected to the storage battery and compensator neutral bus. Storage batteries are installed in all stations to insure continuity of service.

The company maintains several branch offices, the largest of which is at 424 Broadway. From the viewpoint of beauty and interior lighting the Harlem office on 125th Street shown in

Fig. 10, is superior to any of the others. In order to be prepared for a coal strike or delayed delivery of fuel the company has an immense coal storage yard at Shadyside, on the New Jersey shore, capable of holding 200,000 tons.

Fig. 7—Water Street Substation, New York Edison Company.

On Jan. 1 the New York Edison Company had 100,059 customers; there were fed from its circuits 38,975 arc lamps and 4,342,933 incandescent lamps; the connected motor load was 263,529 hp; the load in vapor arcs, heating apparatus, batteries, etc., amounted to approximately 9595 kw. There is, of course, a large amount of electric cooking and heating apparatus on the company's circuits of which it keeps no record. The total connected load in 50-watt equivalents on Jan. 1 was 8,584,725.

Fig. 8—Typical Substation Building, New York Edison Company.

INTERBOROUGH RAPID TRANSIT COMPANY.

The Interborough Rapid Transit Company operates two main generating stations, the one carrying the subway load being located at Fifty-ninth Street, Eleventh Avenue and North River and the other, feeding the elevated railway lines, being located at Seventy-fourth Street and East River.

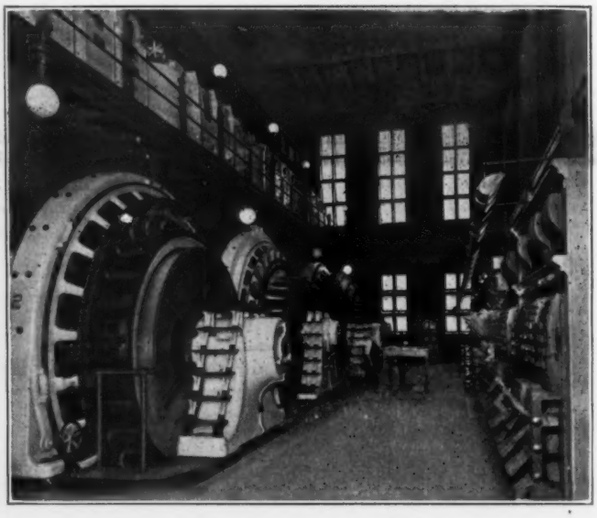


Fig. 9—East Thirty-ninth Street Substation.

The Fifty-ninth Street station is probably one of the most interesting stations in the country, being equipped with five of the largest exhaust steam turbines ever built. The station as originally built was described in these columns Oct. 8, 1904. The power house at present contains nine 7500-kw Allis-Chalmers combined double-horizontal and vertical engines, three Westinghouse turbines rated at 1725 kw each and five Curtis low-pressure turbines, each rated at 7500 kw. The low-pressure turbines are located between and to one side of the reciprocating engines, as indicated in Fig. 11. The relative size

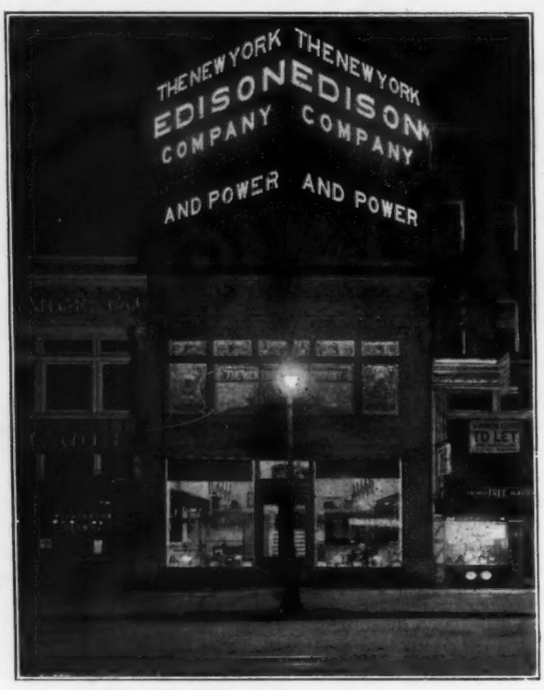


Fig. 10—Harlem Office of the New York Edison Company.

of both units is well shown in this engraving. The dimensions of the engine cylinders are 42 in. and 86 in. in diameter and 60-in. stroke, and the speed is 75 r.p.m. Both pistons on each side of the engine are connected to one crankshaft. Steam enters each hign-pressure cylinder at from 175 lb. to 200 lb. pressure through a 14-in. pipe and from there passes into a receiver through a 16-in. pipe, whence it passes to the low-pressure cylinder. The engines have poppet valves on all the high-pressure cylinders to provide for the use of superheated steam, but the usual Corliss valve gear is supplied to the low-pressure cylinders. The generators driven by the engines are of the Westinghouse revolving-field, flywheel type and are rated at 7500 kw, 25 cycle, three-phase, 11,000 volts.

In the engines not equipped with exhaust-steam turbines the exhaust piping from the engine starts from the condensers with a 30-in. relief valve. From this valve the pipe drops through the main operating floor to the basement, where the exhausts connected the air pipe of the dry vacuum pump. On the side 90 deg. from the steam pipe and the exhaust relief valve, the circulating water enters, while directly opposite in the vapor chamber is the air pump connection. Water for use in the condensers is taken in the North River through a concrete tunnel.

The use of the low-pressure turbines has necessitated changes in the exhaust lines and condensers. The jet condensers are not used on the engines to which exhaust turbines are connected, the turbines being equipped with surface condensers instead. The turbine installed is of the vertical three-stage, impulse type, having six fixed nozzles and six which can be operated by hand so as to control the back pressure on the engine or the division of load between engine and turbine. An emergency over-speed governor which trips a 40-in. butterfly valve on the steam pipe connecting the separator and the turbine and at the same time the 8-in. vacuum breaker on the condenser is the only form of

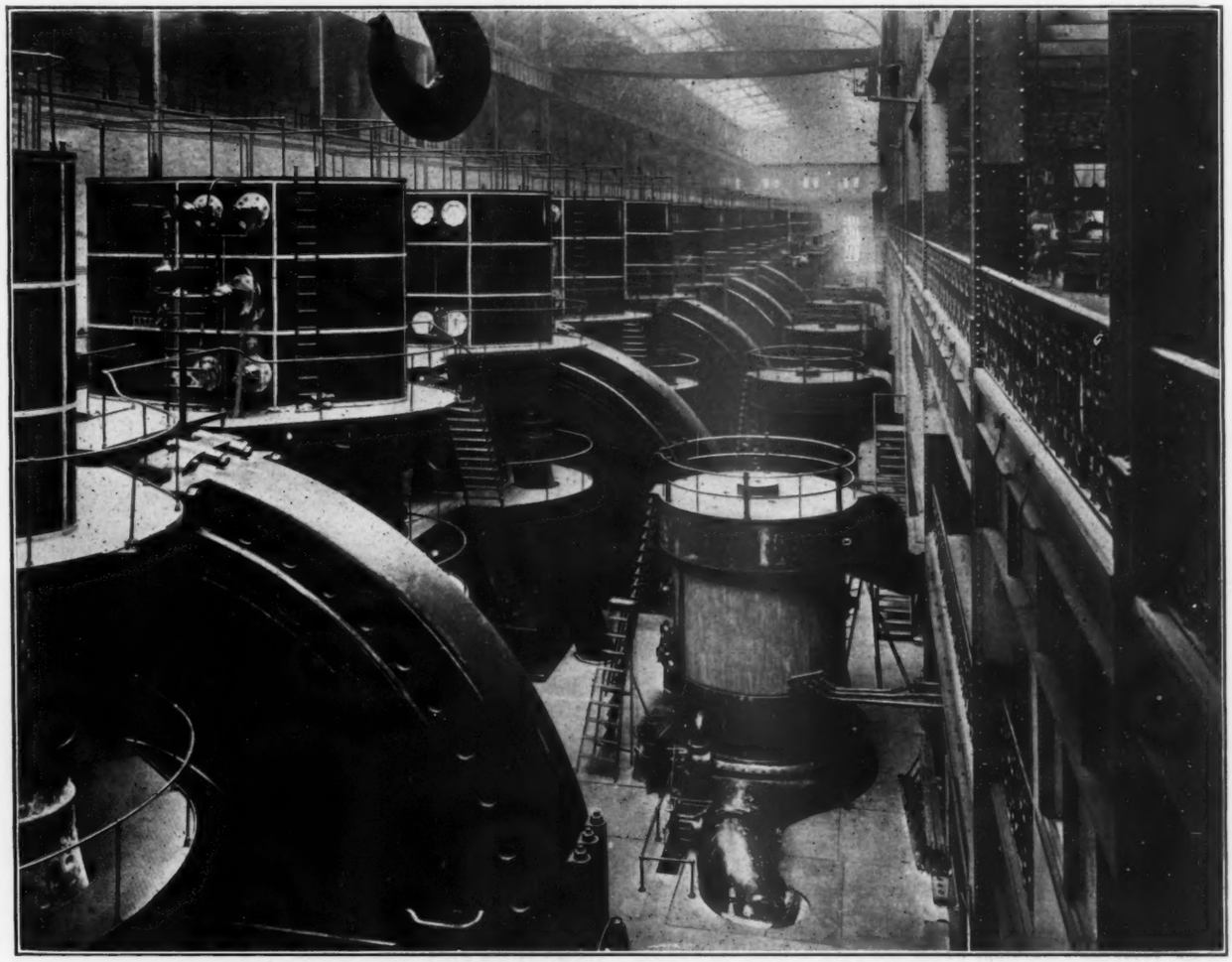


Fig. 11—Generator Room, Fifty-ninth Street Station, Interborough Rapid Transit Company.

from two units unite into one 40-in. riser, which is carried to the roof. The condensing system for each unit consists of two Alberger jet condensers with barometric column discharge, two hot wells of concrete and expanded steel, one dry vacuum pump and one cross-compound circulating pump. Each condenser is supported on specially designed steel work placed in front of the engine and is connected directly to the exhaust outlet of the low-pressure cylinder by means of a single elbow on one side and the relief valve of the atmospheric exhaust line on the other. The condenser head or chamber is 50 in. in diameter and terminates at the bottom in a cone-shaped connection to the tail pipe, while the top is provided with a chamber in which the entrained air and vapor collect and to which is governor used. The condensing plant is capable of maintaining a vacuum within 1.1 in. of the barometric when condensing 150,000 lb. of steam per hour and when supplied with circulating water at a temperature of 65 deg. Fahr. The generator is of the three-phase induction type, wound for 11,000 volts, 25 cycles and a speed of approximately 750 r.p.m. The rotor is of the squirrel-cage type with bar winding connecting into common busbar straps at each end. This type of generator was chosen as being especially suited to the conditions obtaining in the station. The absence of fields leads to the simplest possible switching apparatus, as the induction generator leads are tied in solidly through knife switches, which are never opened, to the main generator leads. The switchboard operator has

no control whatsoever over the induction generator and only knows it is present by the increased output indicated on his instruments. The method of starting the combined unit is simplicity itself. The engine generator is excited before starting the engine and then the latter is brought up to speed and synchronized in the usual manner. While starting in this way, the induction generator acts as a motor until sufficient steam passes through the engine to carry the turbine above synchronous speed, when it immediately becomes a generator and picks up the load.

The net results obtained by the installation of the turbine units may be summarized as follows: An increase of 100 per cent in the maximum rating of the plant; an increase of 146 per cent in the economic output of the plant; a saving of approximately 85 per cent of the condensed steam for return to the boilers; an average improvement in economy of 13 per cent over the best high-pressure turbine results; an average improvement in economy of 25 per cent (between the limits of 7000 kw and 15,000 kw) over the results obtained by the engine units alone; an average unit thermal efficiency between the limits of 6500 kw and 15,500 kw of 20.6 per cent.

trically driven and one is steam driven. The engines are equipped with barometric condensers and the turbine is fitted with a surface condenser.

The energy from both the subway and Manhattan stations is transmitted to substations, where it is rendered available for railway circuits by six-phase rotary converters. The combined rating of the two stations is 177,675 kw.

BROOKLYN EDISON COMPANY.

The system of the Edison Electric Illuminating Company of Brooklyn is described in detail elsewhere in this issue. The company operates two generating stations, one at Gold Street and the East River and the other at Sixty-sixth Street, Bay Ridge and New York Bay. There is a total of forty-eight boilers, with an aggregate rating of 29,200 hp, at present installed, equipped with either flat grates or Taylor stokers. Five engines, with a maximum rating of 13,500 kw, and four turbines, with a maximum rating of 36,750 kw, each connected to alternating-current generators, comprise the equipment. The maximum load carried by the Gold Street station is 23,500 kw and by the Sixty-sixth Street station, 13,500 kw. The company

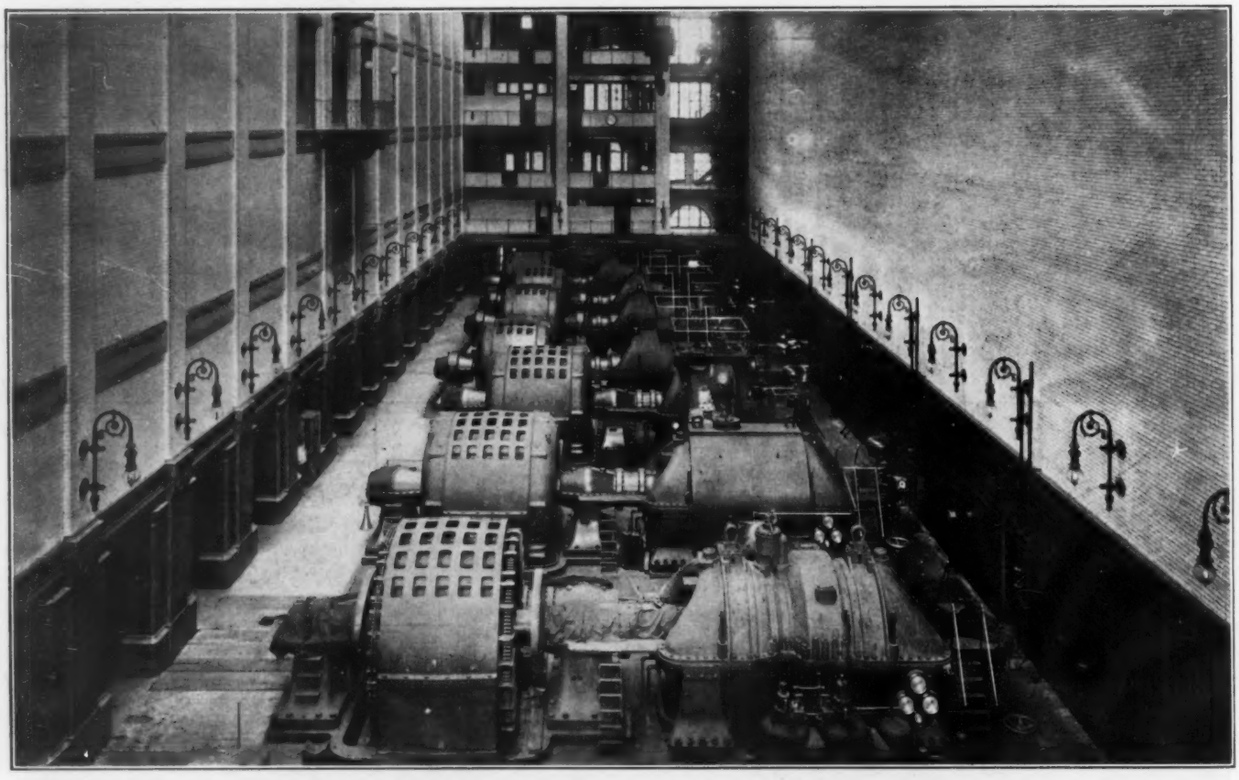


Fig. 12—Main Generating Station of the Transit Development Company in Brooklyn.

The three Westinghouse turbine units are 60-cycle, three-phase, 11,000-volt machines which carry the lighting load of the subway tunnels and stations. The steam for the station is generated in sixty 600-hp Babcock & Wilcox boilers, all of which are fitted with Roney stokers. As at present operated, 85 per cent of the load of the station is carried by the combination engine-turbine units, the straight engine units being used only at times of peak load.

The station feeding the Manhattan elevated system is equipped with sixty-four Babcock & Wilcox boilers rated at 535 hp, the furnaces of all of which are fitted with Roney stokers. The generating equipment consists of eight Allis-Chalmers combined horizontal and vertical Corliss engines driving 7500-kw, 11,000-volt, 25-cycle, three-phase Westinghouse revolving-field alternators and one 7500-kw Westinghouse turbine, the generator of which has the same rating as the other generators of the station. Eight of the feed pumps in this station are electrically driven and one is steam driven. The engines are equipped with barometric condensers and the turbine is fitted with a surface condenser.

has on order a 12,000-kw Curtis unit which will soon be installed in the Gold Street station

QUEENS BOROUGH GAS & ELECTRIC COMPANY.

The generating station of this company is located on Bayswater Inlet, Far Rockaway. The boiler equipment consists of two 600-hp Babcock & Wilcox boilers and six others of the same make rated at 230 hp. The furnaces are fitted with Treadkill grates and the steam pressure under which the engines are operated is 150 lb. There are two 300-kw and one 600-kw American & British Manufacturing Company (Providence, R. I.) engines driving General Electric generators, one 2000-kw vertical and one 2500-kw horizontal Curtis turbine The maximum load carried by the station is 2800 kw. The company operates one substation at Rockaway Beach, 6 miles from the generating station. The distribution system is 2300 volts, two-phase, and the transmission system 6600 volts, three-phase.

TRANSIT DEVELOPMENT COMPANY.

The Transit Development Company generates all the electricity used by the Brooklyn Rapid Transit system, which operates all of the elevated lines and the greater part of the surface lines in the Borough of Brooklyn. The Transit Development Company has at present in active operation three generating stations, termed the "eastern," "central" and "Williamsburg" stations, located respectively at Kent Avenue and Division Avenue, Third Avenue and Second Street, and Kent Avenue and Wallabout Canal. In addition, the company has in reserve three direct-current stations capable of generating approximately 12,000 kw.

The "eastern" power station is equipped with thirty-six Babcock & Wilcox water-tube boilers rated at 250 hp and operating at a pressure of 160 lb. The furnaces are fed with a mixture of bituminous and No. 3 anthracite, burned on dumping grates. The generating equipment comprises seven cross-compound engines, one rated at 4000-6000 hp. and the other six rated at 2000 hp. The generators are 550-600-volt, compound-wound, direct-current machines, one rated at 2700 kw, four rated at 1500 kw and two rated at 1600 kw. The auxiliaries are steam driven throughout and the maximum peak load carried is 12,000 kw.

At the Third Avenue power station there are thirty-two Aultman & Taylor water-tube boilers rated at 650 hp and operating under a pressure of 175 lb. The furnaces are fitted with dumping grates and a mixture of bituminous and No. 3 buckwheat coal is burned. The generating equipment comprises eight 4000-6000-hp cross-compound engines driving 2700-kw generators. Two of these are 550-600-volt, direct-current, compound-wound machines and six are 6600-11,000-volt, three-phase, 25-cycle alternators. The auxiliaries in this station are steam and electrically driven and the maximum load carried is 25,000 kw.

The main generating station of the company is that located at Kent Avenue and Wallabout Canal. This is a very modern station, equipped throughout with horizontal steam turbines. The steam-generating system consists of seventy-two 650-hp Babcock & Wilcox water-tube boilers operating under a pressure of 180 lb.; thirty-six of the units are equipped with dumping grates for burning a mixture of bituminous and No. 3 buckwheat and the other thirty-six boilers are fitted with stokers for burning bituminous coal. The electric generating apparatus in this station comprises four 7500-kw horizontal single-flow Westinghouse turbines and four 10,000-kw horizontal double-flow Westinghouse turbines generating 6600-11,000-volt, three-phase, 25-cycle energy. The four smaller units rest on reinforced-concrete foundations whereas the larger units rest on steel columns. In these latter units the steam enters the cylinder at the center and flows in opposite directions, thereby doing away with the usual balancing pistons and dummy and eliminating end thrusts. Two of the small turbines are equipped with surface condensers, having motor-driven centrifugal hot-well pumps and engine-driven circulating pumps. The other two small turbines are equipped with surface condensers with single-stage, volute, motor-driven hot-well pumps and turbine-driven centrifugal pumps. The condensing equipment for all of the large units is alike. The condensers are of the two-pass, dry-tube type with turbine-driven, single-stage, volute, hot-well pumps and engine-driven, volute, circulating pumps. The maximum load carried by this station ranges between 65,000 kw and 70,000 kw.

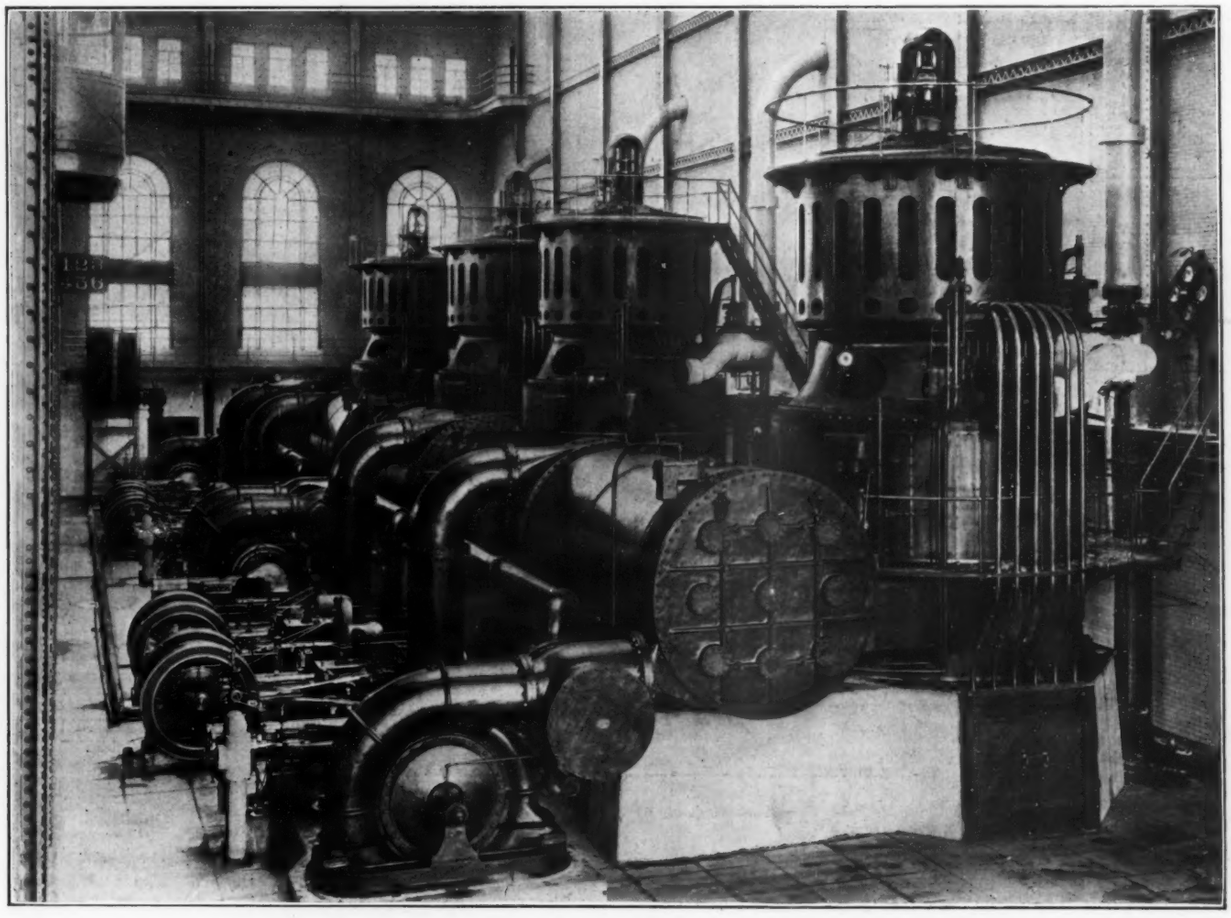


Fig. 13—Port Morris Station of the New York Central Railroad.

NEW YORK CENTRAL RAILROAD.

The electricity to operate the cars and locomotives of the electric lines of the New York Central Railroad is generated in two power stations; one at Yonkers, on the Hudson River, the other at Port Morris, on Long Island Sound. Both stations

are almost duplicates, but only the Port Morris, at 138th Street and Long Island Sound, is within the city limits. A view of this station is shown in Fig. 13.

The present station generating equipment comprises sixteen Babcock & Wilcox boilers rate at 625 hp and having a working steam pressure of 185 lb. The furnaces are fitted with Roney stokers on which Clearfield semi-bituminous coal is burned. The products of combustion pass out of two radial brick stacks 15½ ft. inside diameter and 250 ft. above the grates. Fuel is brought to the station either by rail or coal barges. The coal is deposited into concrete-lined hoppers which discharge into the hoppers of two coal crushers; from there the fuel is fed to an elevating conveyor of the bucket type, which carries it to a point over the bunkers, whence it is distributed by four suspended-flight scraper conveyors operating independently. With the exception of the hoist used to unload the coal boats, the coal and ash-handling machinery is driven by electric motors ranging in size from 7½ hp for the ash conveyor to 40 hp for the coal crushers and conveyors. The motors are of the three-phase induction type and operate at a potential of 220 volts. From the coal bunkers fuel is discharged to the hoppers of the stokers through cast-iron chutes and distributing aprons. The ashes are discharged into hand push-cars of 1-ton capacity, which deposit their contents into conveyor hoppers in the basement beneath the boiler-room, whence the ashes are carried up by a malleable-iron bucket conveyor to storage bins over the trestle and loaded thence into cars.

The apparatus in the station is divided into groups. Each generating unit is provided with four boilers, one feed pump and feed-water heater and a complete condensing plant. The generating room is at present equipped with four 5000-kw General Electric turbo-alternators; the turbines are Curtis five-stage machines mounted on cast-iron bases forming exhaust chambers which are provided with condenser openings and free exhaust connections. The condenser equipment is of the Worthington make and is external to the base of the turbines.

The alternators are of the revolving-field type, generating three-phase current at 25 cycles and 11,000 volts. The armatures are star-connected and the neutrals are grounded through individual cast-iron grid resistors connected to a common ground bus, limiting the ground current under all conditions to the amount necessary to operate the overload relays on the line switches. The exciter system comprises two 150-kw horizontal steam turbines operating non-condensing. There is an additional exciter consisting of an induction motor-generator set delivering 1200 amp at 125 volts. The induction motor, which is a 25-cycle, 200-hp machine, is started by a special switch which puts the transformer windings first in delta then in star connection.

The entire electrical equipment in the station is controlled from the switchboard gallery on one end of the generator room; the lamp and motor circuits in the station being controlled from smaller switchboards situated at either end of the gallery. Separated from the main station is a switch house containing all the high-tension switching apparatus. Two sets of high-tension busbars are provided, each of which is subdivided into two and three sections by tie switches. The high-tension busbars are connected to the generators through a main switch and two selector switches. Each feeder is provided with two selector switches which connect to the two respective high-tension busbars below them. Overload relays are connected in the generator and feeder circuits, and the former has in addition reverse-power relays connected to indicating lamps. The Port Morris station is tied with the Yonkers power station by a transmission line partly underground and partly overhead. The maximum power load carried by the station is approximately 20,000 kw.

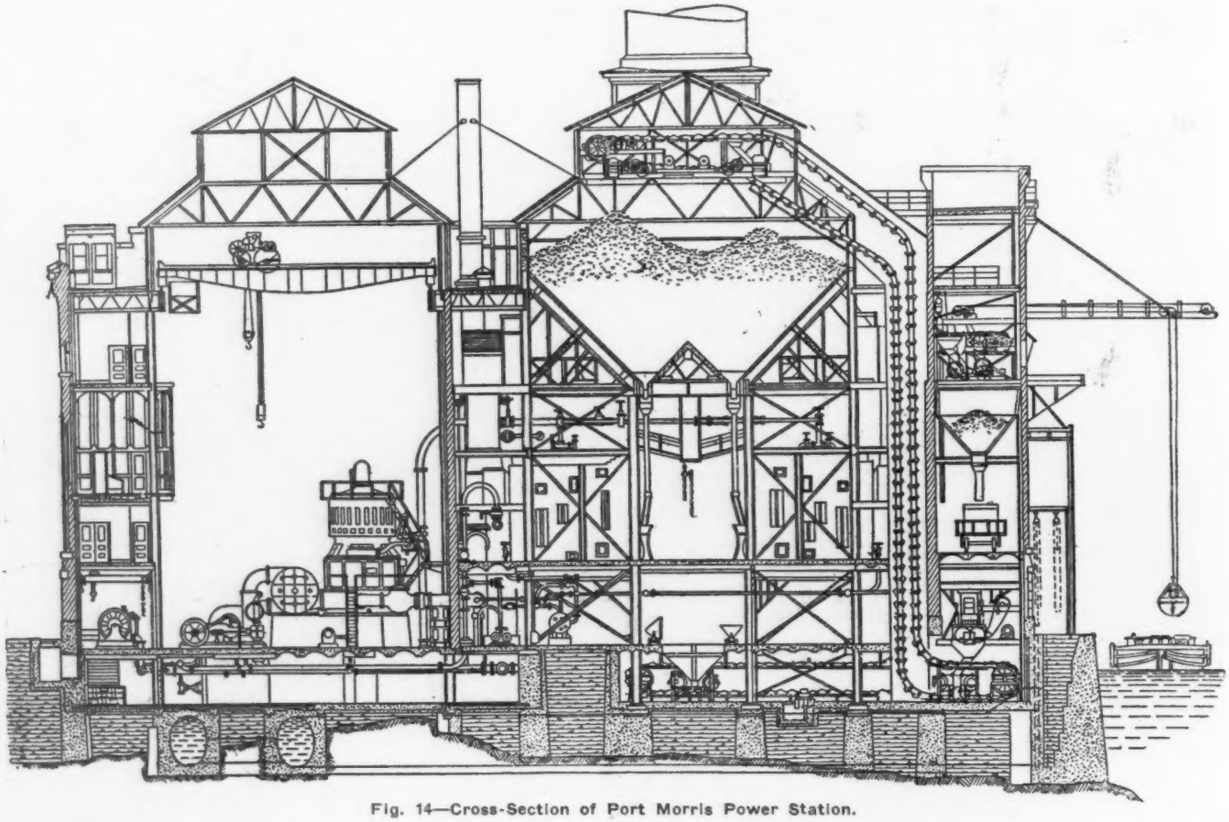


Fig. 14—Cross-Section of Port Morris Power Station.

PENNSYLVANIA TUNNEL AND TERMINAL RAILROAD COMPANY.

This company generates the electricity used for operating the trains of the Pennsylvania Railroad Company and the Long Island Railroad Company, a subsidiary organization, in and out of Manhattan Borough, New York City. The service plant for the electrical equipment in the Pennsylvania Railroad terminal at Seventh Avenue, Thirty-second and Thirty-third Streets is located on Thirty-first Street, opposite the station.

The station from which the electrical energy for operating the trains is received is located in Long Island City on the East River, almost directly opposite the Waterside stations of the New York Edison Company on the Manhattan shore. The Long Island City station contains at the present time two 3000-kw and three 5500-kw, single-flow and two 8000-kw double-flow Westinghouse turbines driving 11,000-volt, 25-cycle and 60-cycle machines; the two small turbines supplying the electricity and the higher frequency. This station will ultimately be extended to house about 105,000 kw in generating equipment. The boiler room contains thirty-two 525-hp Babcock & Wilcox boilers generating steam at 200 lb. pressure and 200 deg. superheat. The furnaces, which have been remodeled since the station was built, are equipped with arches and the improved type of Roney stokers, on which bituminous coal is burned. The 5500-kw units are fitted with surface condensers and the 3000-kw and 8000-kw units have Le Blanc condensers. It will, of course, be understood that the 25-cycle generators furnish the energy for traction purposes and the 60-cycle machines the energy for lighting the tunnels and station and motor service for pumping and ventilating the tunnels and station. The location of the station on the East River makes it possible to receive coal either by water or by rail, but the plant was designed more particularly to deal with coal brought to the station in barges. The ash and coal conveying equipment is in three parts, a coal-hoisting tower, a cable-way for conveying the coal from the tower to the coal pocket and an ashbin structure. The top of the hoisting tower is about 170 ft. above the dock, and equipment is provided for unloading 400 tons of coal in five hours. The maximum peak load covered by the station is approximately 30,000 kw. In addition to this equipment there is located in the service plant of the terminal in Manhattan two 1000-kw, 60-cycle, three-phase, 240-volt turbo-alternators. These are operated non-condensing during the winter, the exhaust steam being utilized for heating the terminal. During the summer months, and as a relay against accidents, two electric cables passing through the East River tunnels and connecting with two 3000-kw, 60-cycle turbo-generators at the main station at Long Island City, supply the electricity to the service station. The same generators are also used for supplying energy for lighting the tunnels.

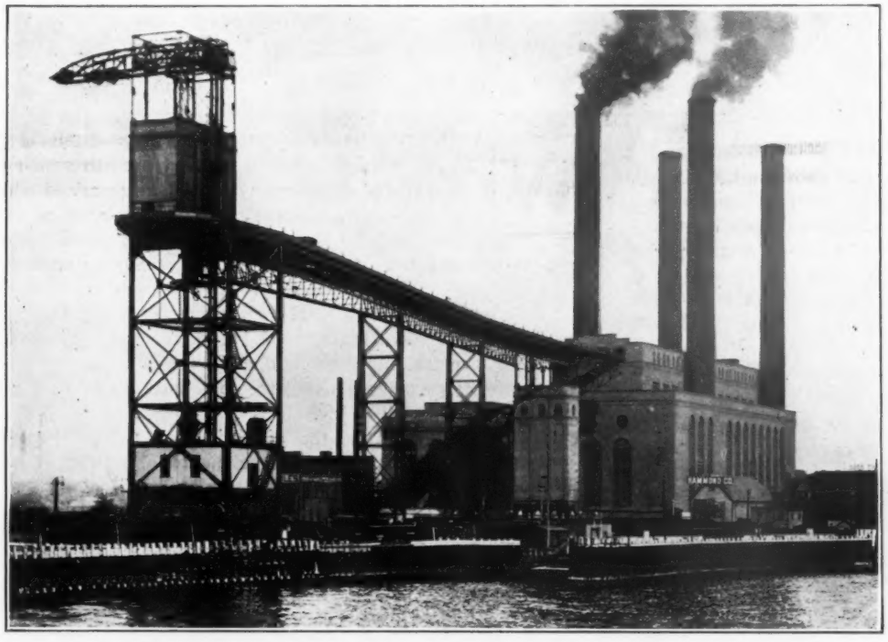


Fig. 15—Main Generating Station of Pennsylvania Tunnel and Terminal Railroad Company.

NEW YORK & QUEENS ELECTRIC LIGHT & POWER COMPANY.

The station of this company is located at Astoria, L. I., and from it substations at Flushing, Jamaica, Maspeth, Long Island City and Bayside are supplied with energy for redistribution. The station is equipped with ten water-tube boilers having an aggregate rating of 4360 hp and operating under a steam pressure of 160 lb. The engine equipment comprises three vertical 850-hp units, driving as many 725-kw Stanley alternators. There are in addition two 3000-kw Westinghouse turbines driving two-phase, 60-cycle, 2200-volt machines. The maximum peak carried by the station is approximately 5000 kw.

FLATBUSH GAS COMPANY.

This company, which is controlled by the Brooklyn Union Gas Company, has a franchise for supplying electrical energy in Flatbush, Brooklyn, and along the Ocean Parkway from Flatbush to Coney Island. The generating station is located at 273 Clarkson Street, and the equipment comprises six horizontal tubular boilers rated at 2100 hp and generating steam at 150-lb. working pressure. No. 3 buckwheat coal is burned in the furnaces on pin-hole grates. There are two 450-hp vertical and one 225-hp horizontal cross-compound engine driving two 300-kw and one 180-kw, 2200-volt, two-phase machine. There are also two turbines, a 750-kw and a 2500-kva machine, connected to generators of the same characteristics as the others. The maximum peak load carried by the station is 1550 kw.

BRONX GAS & ELECTRIC COMPANY.

This company operates a station on the west bank of Westchester Creek, from which the annexed district north of the Bronx River, with the exception of the district known as Williamsbridge, is supplied with electricity. The steam equipment comprises four Babcock & Wilcox boilers having a total rating of 1400 hp. The furnaces are fitted with dumping grates for burning a mixture of bituminous and anthracite coal, and the working steam pressure is 160 lb. The engine room contains two 450-hp Ball & Wood vertical, cross-compound condensing units direct-connected to as many 300-kw, 60-cycle, 2300-volt, two-phase General Electric alternators. There are in addition a 750-kw Westinghouse turbo-generator and a 2000-kw General Electric horizontal turbo-generator. The maximum peak load carried last year by the station was 900 kw.

CONEY ISLAND & BROOKLYN RAILROAD COMPANY.

The generating system of this company was entirely rebuilt in 1908, all of the equipment being located in a single station at Ninth Street and Gowanus Canal, Brooklyn. The station contains at the present time two 3500-kw, 11,000-volt, three-phase, 25-cycle General Electric turbo-generators fed with steam from six Babcock & Wilcox water-tube boilers aggregating 3600 hp. All of the boilers are furnished with Webster furnaces and grates designed to burn a low grade of anthracite coal. The boilers operate at a pressure of 180 lb. with 100 deg. superheat. Coal for the station is taken from the barges by clam-shell buckets, which empty into a hopper feeding a scraper conveyor, which passes over three vertical steel pockets, each of about 700 tons capacity. These pockets are located in the canal bank. The boiler room can be extended to house ultimately 9600 hp; there is likewise plenty of room for new turbines and switchboard extensions. Inasmuch as the water in Gowanus Canal at the present time is not fit for use in a surface condenser, being fouled with the refuse of oil refineries and chemical factories,

Alberger barometric condensers are employed in connection with the turbines. In order to obviate the usual trouble from leakage of the intake lines when the water in them is under pressure, the intake pipe which carries the water from the canal to the condenser was placed below water level. The circulating pumps are driven from vertical motors located on the turbine room floor, a separate pump and motor being provided for each turbine. Each motor is rated at approximately 100 hp and is of the variable-speed type, so that at light loads in the winter it will not be necessary to run at maximum speed.

METROPOLITAN STREET RAILWAY COMPANY.

The generating station of this company, which operates a number of surface lines in Manhattan Borough, is located at Ninety-sixth Street and East River. The station contains fourteen 325-hp and sixty-six 250-hp Babcock & Wilcox boilers operating at a pressure of 155 lb. and burning a mixture of hard and soft coal in Roney stokers. The station equipment generates energy at 6600 volts, 25 cycles, three-phase, in eleven 3500-kw General Electric units. The engines are of the Allis vertical, cross-compound, condensing type, all of the auxiliary apparatus being steam driven. The maximum load carried by the station is 43,000 kw.

THIRD AVENUE RAILROAD COMPANY.

The power station of this company is located on the Harlem River at 216th Street and Ninth Avenue and the power house is usually referred to as the "Kingsbridge" station. The river affords an abundant supply of condensing water and facilities for the delivery of coal in barges. The mechanical design of the station embraces the multiple-unit idea noticeable in large power stations, but the engine and boiler equipment is divided into four distinct plants, each of which may be independently operated and yet all so thoroughly interconnected that they can form a single unit. The equipment consists of eight vertical, cross-compound engines directly connected to 6600-volt, three-phase, 25-cycle, 3500-kw Westinghouse generators. The boiler plant is composed of thirty water-tube boilers set in batteries of 1000 hp each. The coal bunkers are on top of the boiler room, fuel being delivered to them by conveyors and fed from them by gravity to automatic stokers, with which the boilers are equipped. Ashes are handled by gravity from the ash pits to a conveyor in the basement, whence they are taken to bunkers at the dock, which discharge into barges. One feature of the lay-out is the adoption of a large central condensing plant of the barometric type serving the entire station. Each condenser receives the exhaust from four units. All of the auxiliary apparatus is steam driven.

RATING OF NEW YORK GENERATING STATIONS.

Name of Company.	Rating in Kilowatts.
New York Edison Company	249,000
Interborough Rapid Transit Company	177,675
Transit Development Company	115,500
Edison Electric Illuminating Company of Brooklyn	62,250
Pennsylvania Tunnel & Terminal Railroad Company	40,500
Metropolitan Street Railway Company	38,500
Third Avenue Railroad Company	28,000
New York Central Railroad	20,000
New York & Queens Electric Light & Power Company	8,175
Coney Island & Brooklyn Railroad Company	7,000
Richmond Light & Railroad Company	6,400
Queens Borough Gas & Electric Company	5,700
Flatbush Gas Company	4,030
Bronx Gas & Electric Company	3,350
Staten Island Midland Railway Company	900
Bowery Bay Electric Light & Power Company	660
Total	767,640

RICHMOND LIGHT & RAILROAD COMPANY.

This company operates a power station at Livingston, Staten Island. According to the last report of the Public Service Commission the company has fifteen boilers, having an aggregate rating of 5550 hp, five reciprocating engines, with an aggregate rating of 3900 hp, and three turbines with a total output of 2500 kw. There are three direct-current machines having a total output of 1600 kw, and five alternators with an aggregate rating of 3500 kw.

OTHER COMPANIES.

The Bowery Bay Electric Light & Power Company operates its plant only during the summer months, all of the energy being sold to tenants at the amusement resort known as North Beach, borough of Queens. The equipment comprises five boilers, aggregating 1100 hp, and two engines driving two direct-current generators, with an aggregate rating of 660 kw. The Staten Island Midland Railway Company operates a power station at Grassmere, Staten Island, having a rated output of 900 kw.

NEW YORK EDISON COMPANY

REBUILDING OF WATERSIDE STATION NO. 1 OF THE NEW YORK EDISON COMPANY.

WITHIN the last few years the business of the New York Edison Company has increased to such an extent that the company finds it necessary to add to its generating equipment on a large scale. This will be done by removing four of the eleven very economical 3500-kw vertical marine-type engines at the Waterside No. 1 station, at Thirty-ninth Street and First Avenue, and installing in their place three Curtis six-stage vertical turbines, each rated at 20,000 kw. One of the five smaller turbines now in operation at the station will be rewound for 9000 kw, making the total increase of normal generating capacity 50,000 kw.

The present equipment of the Waterside No. 1 Station consists of the eleven vertical, marine-type engines direct-connected to 3500-kw generators, three 5000-kw vertical turbines and two 10,000-kw vertical turbines, making the present total normal generating rating 73,500 kw. It will thus be seen that without increasing the size of the building, including boiler and engine-rooms, etc., it is proposed to increase the normal output of the station over 68 per cent.

The work will not only involve mechanical and electrical changes, but architectural and structural modifications as well.

As previously stated, at the Waterside No. 1 Station there are eleven vertical, marine-type, compound, condensing engines and each is direct-connected to a 3500-kw alternating-current generator. Four of these engines, Nos. 2, 4, 6 and 8, are at present being dismantled. These engines were designed by the Westinghouse Machine Company in co-operation with the engineering department of the New York Edison Company, and represent the most highly developed type of engine for central-power-station work. While running at a speed of 76.3 r.p.m. (the normal speed is 75 r.p.m.), with a steam pressure at the throttle of 185.6 lb., with a vacuum of 27.25 in., the engines have indicated 5442 hp with a consumption of only 11.93 lb. of dry steam per ihp-hour. Though rated as having its highest efficiency somewhere between 4900 ihp and 5500 ihp, the engine is designed to carry a load of 9000 hp if needed. An examination of the tabulated data of tests made in January and February, 1904, by Mr. Jay M. Whitham, acting as referee for the New York Edison Company and the Westinghouse Machine Company, will give a clear idea as to the economy of these engines.

DETAILS OF ENGINES.

The high-pressure cylinder of the engine, 43½ in. in diameter and fitted with poppet valves, is located between the two low-pressure cylinders, which are 75½ in. in diameter and fitted with valves of the double-ported Corliss type. The stroke is 5 ft. and the normal speed 75 r.p.m. The valves are actuated from eccentrics on a lay shaft which is driven through helical gears by a vertical shaft, which in turn is driven through heli-

cal gears by the main shaft. To facilitate synchronizing the speed of the engine can be varied from the electrical control gallery by a pilot switch operating an electric motor which shifts the weight on the governor arm.

The crankshaft, 26 in. in diameter, is built up in three sections, with a 10-in. hole extending from end to end. It is supported in four bearings, three main bearings being each 60 in. long and the outboard bearing 48 in. long. There are three cranks set at angles of 101 deg., 133 deg. and 126 deg. respectively, thus giving a uniform turning moment and making unnecessary a heavy flywheel. A weight of 90,000 lb. in the rim, with an outside diameter of 23 ft., is sufficient to give the required steadiness.

The engine frames are of the "A" type, with a substantial bearing on the bedplate. The latter is made in three pieces, proximately 8 ft. high x 7 ft. 6 in. wide x 15 ft. 8 in. long. The efficiency of these units is given in Table I herewith.

The air and circulating pumps are of the horizontal-piston type, double-acting and driven in tandem by a Westinghouse-Corliss engine. The steam cylinder is 16 in. in diameter, the air and water cylinders 32 in. in diameter, with a common stroke of 24 in. The rated speed is 34 r.p.m. These pumps are located beneath the condenser, the condensation flowing by gravity into the cylinder of the air pump.

ALTERNATING-CURRENT GENERATORS.

The 3500-kw alternating-current generators, direct-connected to each engine, are of the three-phase, 25-cycle, 6600-volt revolving-field type, and were built by the General Electric Company. The revolving core is keyed to the engine shaft and bolted to the hub of the flywheel, which is extended so as to

Fig. 1—General View of Operating Room, Waterside Station No. 1, Showing Alterations in Progress.

with an extension for supporting the outboard bearing. The space occupied by the generating unit is 918 sq. ft., and the total height from the bottom of the foundation to the top of the engine is 52 ft. ½ in.

ENGINE AUXILIARIES.

There is one Worthington two-pass, surface-type condenser for each engine located beneath the operating floor and beside the engine foundation. Originally each condenser contained 3708 straight brass tubes, ¾ in. in diameter and 12 ft. 9½ in. long, but as a result of tests 440 were removed and the effectiveness of the condensing surface was increased. The cooling surface is now 6874.4 sq. ft. There are two 26-in. inlets at the top of the condenser and the outlet to air pump is 14 in. in diameter. The circulating-water inlet and outlet is 16 in. in diameter. The over-all dimensions of the condenser are ap-

form a heavy flange on the side toward the generator. The coils are wound with copper ribbon set on edge and give full excitation at 220 volts, thus making it possible to take the exciting energy either from the low-tension board or from the storage battery in case of failure of the exciter sets.

SELECTION OF NEW GENERATING UNITS.

From a consideration of what has already been written in regard to the economical performance of the engines and auxiliaries at the Waterside No. 1 Station, it will be concluded that the reason why the New York Edison Company decided to dismantle units of such efficiency and replace them by turbines whose performance cannot be much better is simply because of the very large increase in output per square foot of floor area which can be gained by doing so.

Where it is a question of increasing the output per square

foot of floor area the instalment of the vertical turbo-generator set is, of course, the solution. As indicative of the conservation of area made possible by this means a table of comparative data of steam-power plants is given in Table II. From this it will be seen that the Waterside No. 2 Station of the New York Edison Company has 0.733 sq. ft. per kilowatt of output, which is the least number of square feet per kilowatt output of any of the stations mentioned. At this station there are six 8000-kw vertical turbines, two 14,000-kw vertical turbines and two 7500-kw horizontal turbines. After the new turbines are placed in the Waterside No. 1 Station the square feet of floor space required per kilowatt of output will be a great deal less than that of the other station mentioned.

TABLE I.—STEAM CONSUMPTION TEST OF NO. 8 ENGINE—WATERSIDE NO. 1.

Number of Column.	1.	2.	3.	4.	5.	6.	7.	8.	9.	10.	11.
Number of hours run	1	1	1	1	4	1	1	2	4	1	1
Pressures:											
Steam at throttle, pounds	185.6	184.2	180.7	183.7	183.3	180.6	184.6	184.2	184.4	186.3	181.6
Steam in receiver, pounds	36.8	33.7	29.2	24.7	23.8	20.8	20.9	22.3	19.7	24.4	24.8
Vacuum at low-pressure cylinders, inches	27.25	27.20	27.3	26.75	26.35	27.25	25.19	24.53	25.34	26.90	26.60
Barometer, inches mercury	....	....	....	30.22	30.16	....	30.42	29.86	30.40	30.22	30.22
Temperatures:											
Exhaust from high-pressure cylinders	284.1	279.8		269.3	268.4		263.4	265.0	261.5	268.4	277.2
Inlet to low-pressure cylinders	284.1	279.8	273.7	268.8	269.7	262.3	263.1	264.7	261.8	268.1	276.8
Exhaust from low pressure cylinders	125.6	126.5	126.0	127.8	131.1	127.4	140.8	140.8	140.1	121.7	133.7
Moisture in steam, per cent	0.75	0.74	0.73	0.92	0.71	0.72	0.70	0.60	0.60	0.80	1.11
Revolutions per minute for each test	76.30	75.85	76.36	76.55	76.40	76.48	76.20	76.93	76.43	76.16	74.50
Total average indicated horse-power	5,442	5,536	5,357	5,598	5,275	5,360	5,310	5,233	5,308	4,218	6,326
Water Measurements:											
Hot well discharge	61,996	63,317	61,162	64,243	60,645	62,002	61,598	61,214	62,854	49,974	75,186
Receiver drip	3,456	3,701	3,725	4,189	3,959	3,856	3,880	4,066	3,649	2,978	4,422
Total water per hour	65,452	67,018	64,887	68,432	64,604	68,858	65,478	65,280	66,503	52,952	79,608
Total dry steam per hour	64,961	66,518	64,412	67,802	64,145	65,385	65,020	64,888	66,104	52,529	78,725
Pounds of dry steam per indicated hp-hour	11.93	12.023	12.015	12.11	12.16	12.19	12.24	12.40	12.45	12.45	12.44

DETAILS OF 20,000-KW VERTICAL TURBO-GENERATORS.

As has been pointed out, the question of floor area limited the selection of the new generating units to those of the vertical turbo type. The three new 20,000-kw units will be of General Electric Company design. The generators will be of the four-pole, three-phase, 25-cycle type wound for 6600 volts. The normal speed will be 750 r.p.m. The generators will be direct-connected to six-stage steam turbines designed to operate on 175-lb. gage pressure with a back pressure of 1½ lb. absolute in the exhaust chamber and with steam superheated 100 deg. Fahr. The steam consumption in pounds per kw-hour with a steam pressure of 175 lb. at the gage and with not more than 1½ in. absolute back pressure in exhaust chamber of turbine is guaranteed to be not more than the following figures indicate:

Kw Output.	Steam Consumption in Pounds.
10,000	15.0
15,000	14.4
20,000	15.0

The dimensions of the base will be 17 ft. 6 in. x 17 ft. The height will be 35 ft. 7 in. It is interesting to note here that the floor area of one of these 20,000-kw units is approximately 297.5 sq. ft., while the 3500-kw engine-generator unit it replaces occupies 918 sq. ft. In other words, six times as much power may be generated in approximately one-third the floor area.

CONDENSING APPARATUS FOR NEW TURBINES.

Each of the new turbines will be connected to condensing apparatus of a highly efficient type as demanded by turbine practice. The condensers will be made up of the condenser base, located directly under the turbine on the same foundation, and a wing condenser on each side. They will be furnished by the Wheeler Condenser & Engineering Company, and will be of the company's "dry-tube" type. The entire condenser will contain 32,000 sq. ft. of 1-in. No. 18-gage tubes and will be complete with hot well and independent air cooler. The condenser base will be furnished by the General Electric Company.

The two hot-well pumps for each unit will be of the 6-in., two-stage centrifugal type and will be direct-connected to a suitable steam turbine. The two circulating pumps for each unit will be 30-in. centrifugals with brass impellers, brass-covered shafts, each pump being direct-connected on a common bedplate to a suitable steam turbine. The manufacturers guarantee one of these units to condense 300,000 lb. of steam per hour with an absolute vacuum of 2 in. and with cooling water of 70 deg. Fahr. or less.

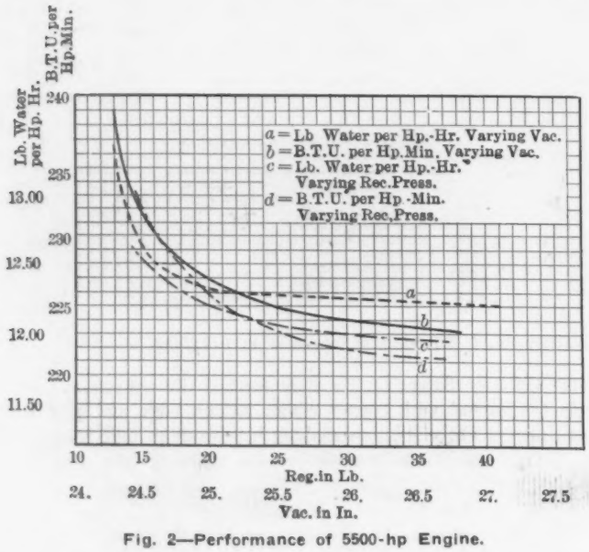


Fig. 2—Performance of 5500-hp Engine.

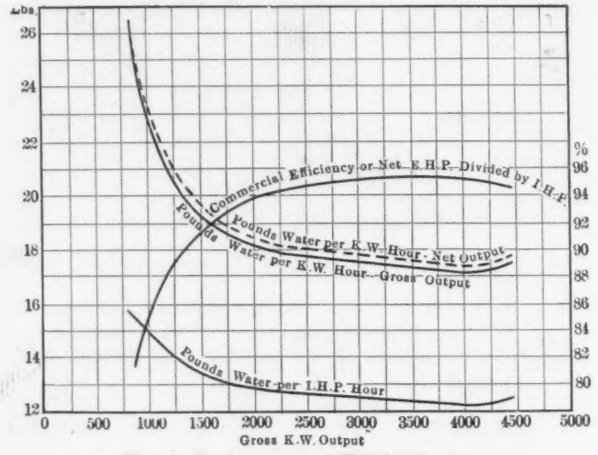


Fig. 3—Performance of 5500-hp Engine

NEW FREE EXHAUST.

A new atmospheric exhaust for the three new 20,000-kw turbines and the present turbines Nos. 10, 12 and 14 will be installed. This exhaust will run along the south basement wall to the East River wall, where it will be connected by a large cast-iron elbow, which is bolted to the foundation by four 1½-in. bolts to the exhaust stack rising about 115 ft. 6 in. above the basement floor. The exhaust head will consequently be above the top of the building.

The exhaust-flue run in the basement will be made of 3/16-in. steel rectilinear sections having inside dimensions of 4 ft. x 3 ft. The length will be about 218 ft., and the height of the center line of the flue from the basement floor will be about 10 ft. 3 in. The length of the sections will range from 9 ft. 7 in. to

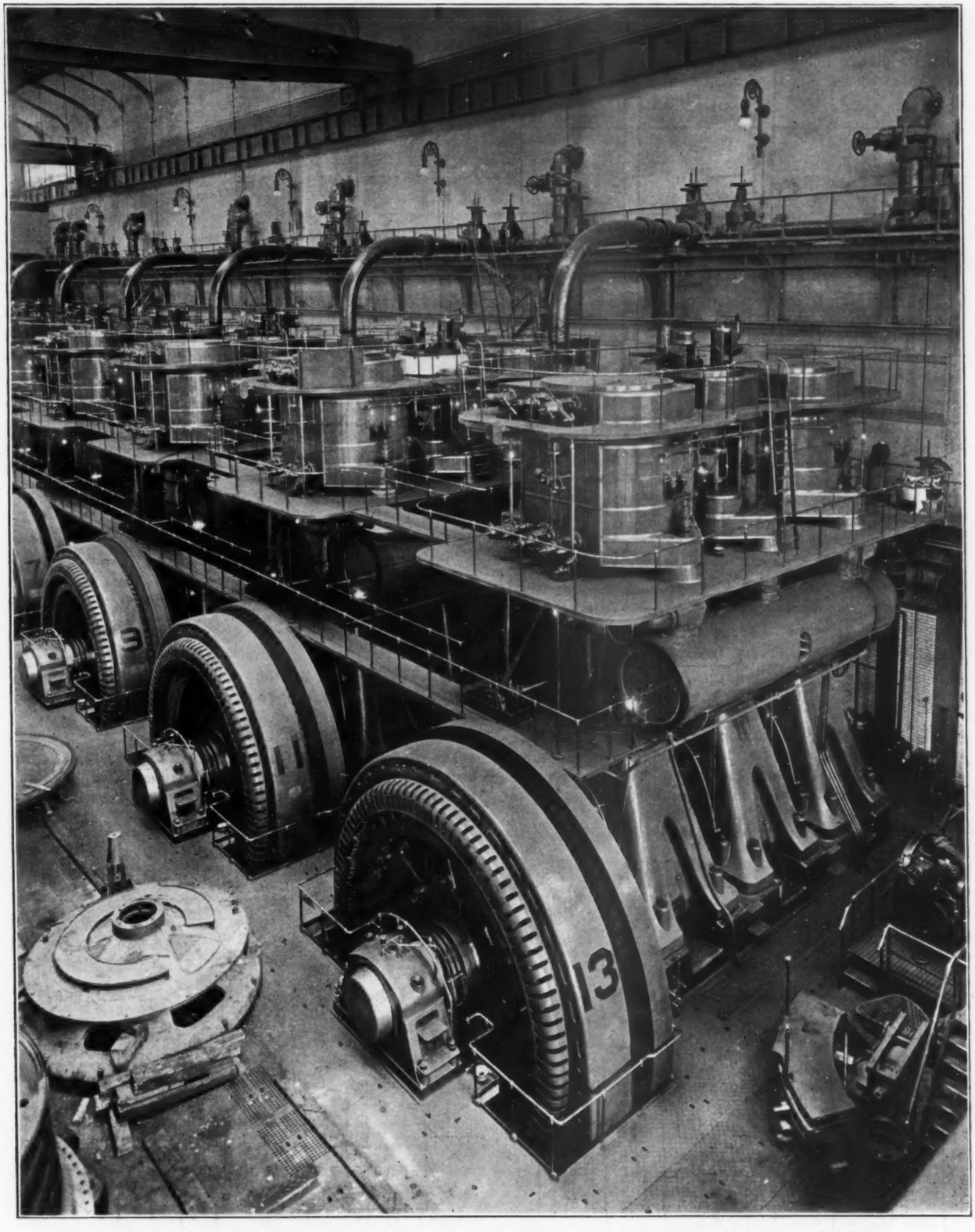


Fig. 4—Remaining Reciprocating Units in Waterside Station No. 1; Four Similar Units Have Been Removed.

11 ft. 3 in. The exhaust stack will be made of ¼-in. steel and have an inside diameter of 4 ft. It is proposed to make the main part in nine sections, eight of 11-ft. 8-in. length and one of 9 ft. The foundation of the stack will be of concrete set on piling. The stack will be held to the building by three sets of saddles and braces.

BOILER HOUSE.

At the present time at the Waterside No. 1 Station there are fifty-four boilers of the Babcock & Wilcox type rated at 650 hp each. They are arranged in two double-tier rows, twenty-eight on the first floor and twenty-six on the second floor, one row on each side of the boiler-room. They are three-drum, double-deck boilers, with 6386 sq. ft. of heating surface, and usually operate on 190-200-lb. pressure.

At present the last four boilers on the east end of the second and first floors are equipped with superheaters. It is now proposed to equip the entire first tier of boilers with superheaters, and as there are twenty-eight boilers on the first floor this means the addition of twenty-four superheaters. There will also be a change in the stoking with the consequent change in the air-supply ducts, coal downtakes, etc.

SUPERHEATERS.

Each superheater will have 767.76 sq. ft. of heating surface, consisting of a forged-steel distributing header, connecting tubes and forged-steel collecting header, with tubes expanded in place so far as space available for insertion of superheater will permit. There will be four 5-in. downtakes and four 5-in. uptakes. The joints at the top of the same will be Van Stone joints. The Babcock & Wilcox Company will supply the superheaters.

MECHANICAL STOKERS.

Ten of the boilers on the first floor of the boiler house will be fitted with Taylor gravity under-feed stokers. On the second floor nine boilers will be equipped with Taylor stokers. New stoker engines and forced-draft apparatus will be installed as necessary.

STEAM PIPING

As superheated steam will be supplied to all the Waterside No. 1 turbines from the twenty-eight boilers on the first floor of the boiler house and the last four boilers on the east end of the second floor, it will be necessary to change all fittings

TABLE II.—COMPARATIIVE DATA OF STEAM-POWER PLANTS.

Building, Approximate.	Metropolitan	Manhattan	Kingsbridge.	New York Edison Company Waterside No. 1.	New York Edison Company Waterside No. 2.	Brooklyn Rapid Transit.	Chelsea, Mass.	Long Island.	Boston Edison.
Dimensions	200x244 av.	204⅔x404	243⅔x319	197x272	197½x341½	201x582	175x453½	200x250	250x650
Area (square feet)	48,800	82,400	78,000	53,720	67,478	117,000	79,400	50,000	162,500
Total floor area, including basement	167,600	207,300	190,800	122,200	260,300	233,000	204,100	126,000	325,000
Cubical contents (total) (cubic feet)	5,580,000	9,060,000	8,850,000	6,499,878	9,463,040	12,943,000	8,450,000	4,670,000	.....
Cubical contents, engine house	2,633,000	4,180,000	4,850,000	3,514,000	2,824,800	7,647,000	3,000,000	1,900,000	.....
Cubical contents, boiler house	2,947,000	4,880,000	4,000,000	2,512,000	6,638,240	5,296,000	5,450,000	2,770,000	.....
Cubic feet per kilowatt output	169	226	184	52.6	102.8	259	139	142	.....
Square feet per kilowatt output	1.48	2.06	1.63	.436	.733	2.32	1.36	1.51	2.71
Generator output, total kilowatts	33,000	40,000	48,000	123,500	92,000	50,000	55,000	33,000	60,000
ENGINES:									
Description	Ver. Cross-Com.	Dou. Cross-Com.	Ver. Cross-Com.	Ver. Com. Ver. Turb. *A	Hor. Turb. Ver. Turb. *B	Dou. Cross-Com.	Hor. Turb.	Hor. Turb.	Ver. Turb.
Rating, each, normal	4000 hp	8,000 hp	4000 hp			8,000 hp	7,360 hp (El.)	7,360 hp (El.)	6700 hp (El.)
Rating, each, maximum	6200 hp	12,500 hp	6200 hp	.....	.....	12,500 hp	11,040 hp (El.)	11,040 hp (El.)	.....

*A.—Waterside No. 1.

No.	Generators.	Engines.
11	3500-kw, 0600-volt, 25-cycle, 3-phase	Vertical compound.
2	10,000-kw, 6600-volt, 25-cycle, 3-phase	Vertical turbine.
1	5000-kw, 6600-volt, 25-cycle, 3-phase	Vertical turbine.
1	5000-kw, 6600-volt, 60-cycle, 3-phase	Vertical turbine.
1	9000-kw, 6600-volt, 60-cycle, 3-phase	Vertical turbine.
3	20,000-kw, 6600-volt, 25-cycle, 3-phase, (being installed.)	Vertical turbine.

*B.—Waterside No. 2.

No.	Generators.	Turbines.
1	14,000-kw, 6600-volt, 60-cycle, 3-phase	Vertical.
1	14,000-kw, 6600-volt, 25-cycle, 3-phase	Vertical.
6	8000-kw, 6600-volt, 25-cycle, 3 phase	Vertical.
2	7500-kw, 6600-volt, 60 and 25-cycle, 3-phase	Horizontal.

TABLE III.—TEST OF CONDENSER OF NO. 13 ENGINE—WATERSIDE NO. 1.

Test No.	Load in Kilowatts.	Pounds Steam Condensed per Kw-hour	Circulating Water, Gallons per Minute.	Ratio Circulating Water, Condensed Steam.	Circulating Water, Inlet Temperature.	Circulating Water, Outlet Temperature.	Vacuum 30-in. Bar.	Velocity Thro' Tubes, Feet per Second
10	4565	17.18	3193	20.6	31.2	85.6	25.2	1.80
11	4507	16.90	3325	22.2	30.0	78.8	25.8	1.88
83	4275	16.71	3060	21.6	31.8	81.8	26.17	1.96
64	4112	16.50	3245	24.3	31.5	77.7	26.4	2.08
76	4000	16.81	3120	23.5	31.6	77.2	26.58	2.00
70	3908	17.07	3098	23.7	32.8	78.0	26.52	1.08
41	3815	16.45	3188	25.8	31.1	74.8	26.78	2.04
53	3705	16.6	3239	27.2	31.0	71.8	26.76	2.07
72	3602	17.31	3140	25.5	31.8	72.8	26.78	2.01
81	3510	15.61	3075	28.5	30.5	70.6	26.46	1.97
27	3427	16.25	3390	30.9	32.8	70.6	28.8	2.17
84	3201	16.6	3095	29.5	31.8	70.7	26.6	1.98
67	3076	16.94	3215	30.3	31.0	67.3	26.74	2.06
52	3008	16.11	2868	30.1	33.0	71.2	26.42	1.84
5	2977	17.33	3188	30.6	47.0	83.5	26.21	1.76
3	2947	16.22	3159	33.5	48.7	81.0	26.22	1.78
31	2857	16.42	3209	34.8	31.2	64.3	27.00	2.05

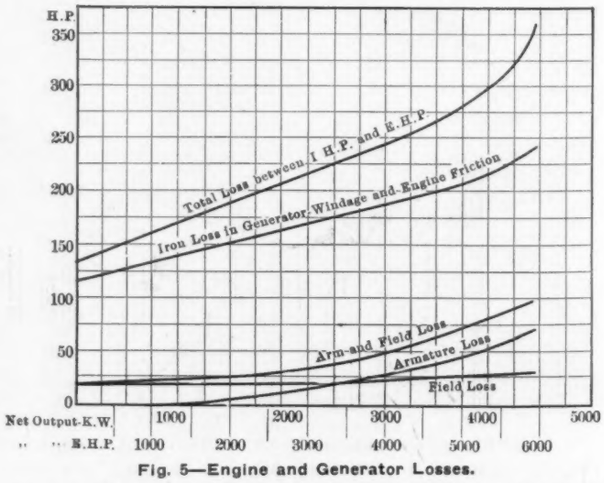


Fig. 5—Engine and Generator Losses.

between these boilers and the turbines to cast steel. At the same time all pipe will be replaced by rolled-steel pipe with New York Edison standard rolled joints.

For turbines Nos. 10, 12 and 14 there was previously an equalizing header in the basement, but this will be removed and each turbine will be connected to the lower run of the main steam header by a direct run. This applies as well to turbines Nos. 4, 6 and 8.

Previously there was a header in the basement for the auxiliaries. This will now be taken down and there will be a 6-in. outlet at each turbine to supply its auxiliaries. Thus each turbine and its auxiliaries will constitute an independent steam unit.

On the direct runs from the lower main header line to each of the turbines Nos. 10-14 and 4 there will be a 6-in. outlet, and at present it is proposed to connect to these a 6-in. header line in the basement and to supply superheated steam to auxiliaries independent of the turbines and engines—that is, for step-bearing pumps, fire pumps, etc. This means that all fittings will be changed to cast steel on such lines.

On the runs to turbines Nos. 4, 6 and 8 from the lower line of main header there will be sections of pipe inserted in such a manner that at any time they can be removed and a Venturi meter connected.

Inasmuch as twenty-two of the twenty-six boilers on the second floor of the boiler house will continue to supply saturated steam to the seven remaining engines and their auxiliaries, and as these boilers have their leaders connected to the upper run of the main header, it will be necessary to provide bends between the upper and lower runs of the main header, since the lower will be supplied with superheated steam. There will, therefore, be placed between the upper and lower runs three S-bends and one U-bend to take care of any difference of expansion.

OILING SYSTEM.

One of the most important parts of a turbine station is the oiling system for the step bearings, sleeve bearings and the hydraulic governors. This system should, above all things, be so constructed that in case of any emergency oil may be secured from another source.

At the present time at Waterside No. 1 Station there are four oiling systems in operation as follows: There is an oil step-bearing system for two turbines (No. 15 and No. 16); an accumulator hydraulic governor system for five turbines (No. 10, No. 12, No. 14, No. 15 and No. 16); a gravity system from a tank house on the roof which supplies cylinder and engine oil to the engines and the reciprocating auxiliaries, pumps, blower engines, etc., and a water step-bearing system for three turbines (No. 10, No. 12 and No. 14).

It is now proposed to have one oil step-bearing system for the three new 20,000-kw turbines (No. 4, No. 6 and No. 8) and two others (No. 15 and No. 16). The water step-bearing system for three turbines (No. 10, No. 12 and No. 14) will remain as it is, as these bearings were designed for water. The hydraulic-governor oil for the new turbines will be supplied by gravity from a new oil-tank on the roof.

ELECTRIC CRANES.

At the present time there are two cranes in the Waterside No. 1 Station which span the engine-room at the curve of the roof. One of these cranes is of 50 tons capacity and one is of 25 tons capacity. The 25-ton crane will be taken down and a new 110-ton Morgan crane with a 10-ton auxiliary hoist will be installed. The new 110-ton crane and the present 50-ton crane will run on the same crane rail. On account of increasing the width of the mezzanines the span will now be 94 ft. 7⅞ in., while before it was 3 ft. 9 in. more than this. The elevation of the crane rails will be 59 ft. 10 in. from the new operating floor. Previously it was 62 ft. from the operating floor.

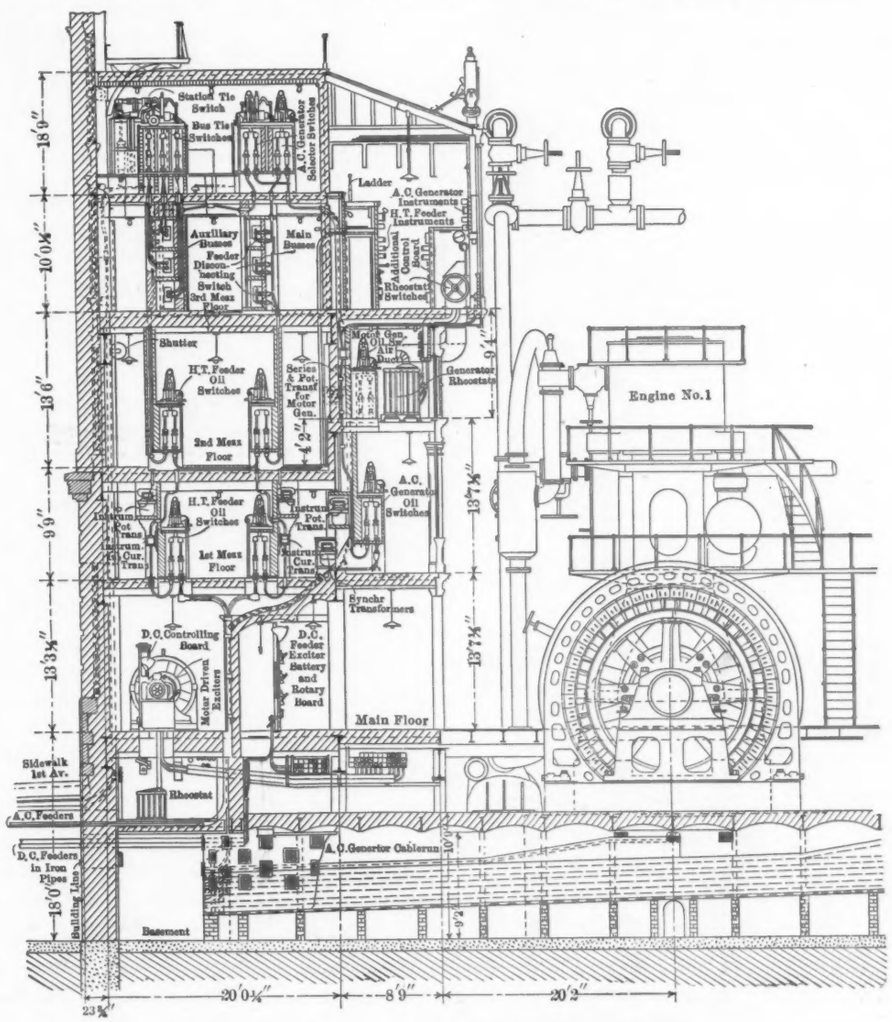


Fig. 6—Cross-Section of Old West-End Electrical Galleries.

ELECTRICAL CHANGES.

In addition to the instalment of the three 20,000-kw Curtis vertical turbo-generator units one of the present turbines (No. 14, rated at 5000 kw and 25 cycles) will have its generator rewound for 9000 kw, 60 cycles. Hence in making the alterations at Waterside No. 1 Station it will not only be necessary to take care of an additional normal equipment of 50,000 kw, but arrangements must be such as to handle an increase of 4000 kw in 60-cycle equipment.

Because of these changes it has been found necessary entirely to alter the south and west-side mezzanine floors and to increase their floor area. The south-side mezzanines will constitute the main electrical galleries, while on the third mez-

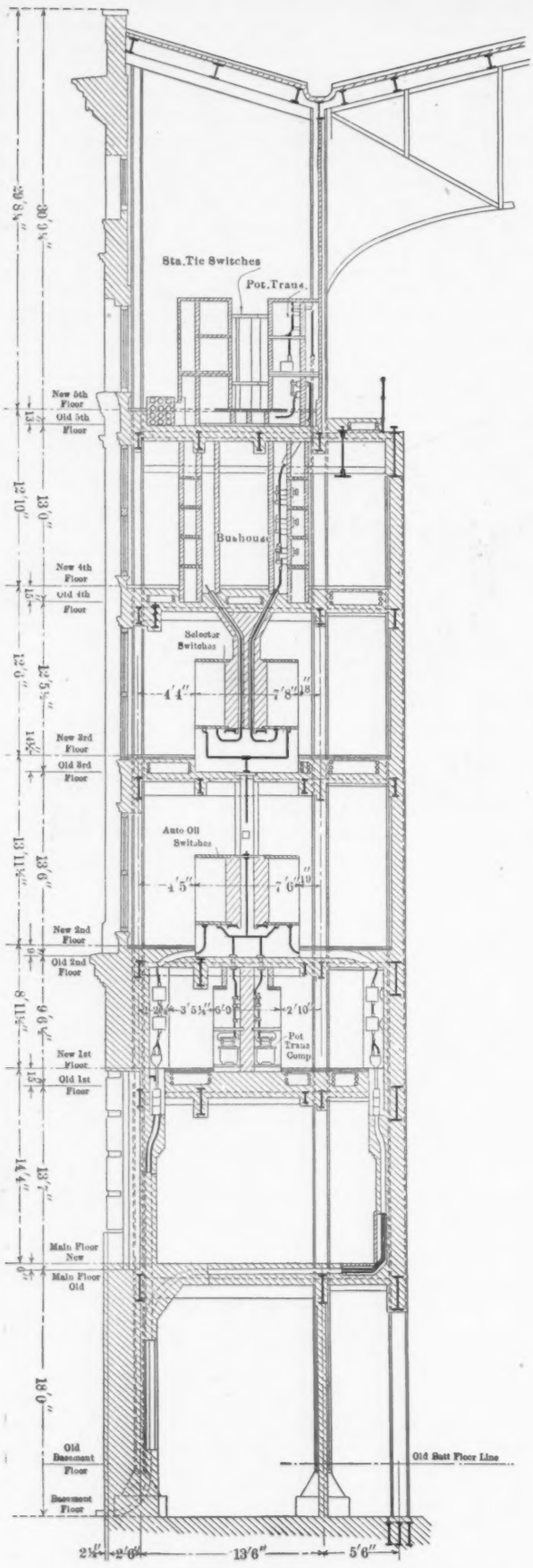


Fig. 7—Cross-Section of New South End Electrical Galleries.

zanine, on the west end, will be located the generator and feed-control boards placed in a horseshoe position. The storage batteries, which heretofore have been located on the south side of the basement, will be transferred to the west end of the basement to the space formerly given over for a cable vault. An entirely new cable vault will be constructed under the sidewalk on the Thirty-eighth Street side of the station.

In designing the new electrical equipment the scheme followed in Waterside No. 2 Station has been followed out as far as possible, and, of course, in some cases an improvement has been effected. Apparatus of the latest type will be installed and only a very small portion of the present electrical equipment will be used.

In order to appreciate the magnitude of these changes and the character, reference should be made to Fig. 6, showing the present arrangement of the apparatus in the west-end galleries at Waterside No. 1 Station, and Fig. 7 showing a cross-section of the south-side electrical galleries, and also Fig. 8, showing the layout of the feeder and generator groups on the third mezzanine floor. The first bus can take care of 54,000 kw, 25-cycle power, the second bus of 49,500 kw, 25-cycle power, the third of 14,000 kw, 60-cycle power. There will be fifty-eight feeders, five exciters, two motor-generator sets and one test set.

On the fifth mezzanine will be located the station tie switches and shunt transformers; on the fourth will be the bus house with main and auxiliary buses; on the third will be the selector switches; on the second the main oil switches, and on the first the transformer compartments. All of the oil switches will be of the General Electric type known as H3.

The high-tension cables will run as directly as possible from the generating units to the mezzanine engine-room wall. A cable tie is made between Waterside No. 1 and Waterside No. 2, connecting each section of the high-tension bus in both stations. The generator and feeder-control boards will be situated on the third west-end mezzanine and they will be of the bench-board type, while previously they were made up of individual pedestals. As shown in the engraving, the concave sides will face each other.

The generator control is to be made up of sixteen control pedestals and the panels will be of blue Vermont marble. The usual instruments will be placed thereon in addition to the engine-signal device connecting with the signal stand adjacent to each engine or turbine. The feeder control is to be composed of seventeen sections and the panels will be of blue Vermont marble. In general, each panel will take care of four feeders.

DIRECT-CURRENT SERVICE.

Heretofore five motor-generators of 500-kw rating have not only supplied Waterside No. 1 Station with energy for lamps and motors, but have also supplied direct-current energy in the neighborhood of the station, part of the generating station having been devoted to distributing purposes as a substation. In the future there will not be any energy supplied from the station to the neighborhood, so only two of the above motor-generators will be kept and they will supply energy to the station only. These sets will be located under the first west-end mezzanine floor.

The direct-current and exciter control boards will remain as they are on the main floor under the west-end mezzanines and the exciters, auto-transformers and the booster set will be located in the same part of the building.

ARCHITECTURAL ALTERATIONS.

The increase of the kilowatt rating of Waterside No. 1 Station from a normal of 67,500 to 123,500 kw has made it necessary to provide larger galleries for the electrical apparatus. The electrical galleries will occupy the five mezzanines on the south side of the building, while the third mezzanine on the west side will be occupied by the feeder and generator control boards. Formerly the south-side mezzanines were occupied by offices, machine shops, storeroom, locker and toilet-room. All of the electrical apparatus heretofore has been located on the west-side mezzanines.

In altering Waterside No. 1 Station the idea was kept in mind to make it as much like the Waterside No. 2 Station

as was possible and practical. The architectural changes are as follows:

BASEMENT CHANGES.

Excavations will be made along the south side wall and a cable vault 242 ft. long and 15 ft. wide will be constructed. This vault will be under the Thirty-eighth Street sidewalk. The roof will be made up of I-beams supported on the present Thirty-eighth Street wall and the vault retaining wall of concrete 3 in. thick. Between the beams will be concrete arches. The sidewalk finish will be granolithic. The height of the vault will be 10 ft. and it will be divided into fifteen compartments by concrete walls 2 ft. 6 in. high, thus preventing the spreading of any fire (due to short-circuits, etc.) to another cable. Any leakage past the duct outlets will be caught in a 12-in. trench running the length of the vault to a sump. There will be three doors from the basement to the vault.

MAIN-FLOOR CHANGES.

Under the south and west-side electrical galleries the main floor—that is, engine-room floor—will be raised 6 in., but in the engine-room itself, south of a line 5 ft. ¼ in. from the center line between the engines as formerly arranged, the floor will be raised 26 in. This raise will be accomplished in general by placing over the present floor framing 8-in. channels on top of which will rest 8-in. I-beams. From the new main floor to the old main floor there will be steps running the whole length of the engine-room. The present cast-iron floor plates, 1⅛ in. thick, will be used as far as possible.

SOUTH-SIDE MEZZANINES.

The width of the south-side mezzanines will be increasel by erecting a new row of steel columns 5 ft. 6 in. on center lines from the present row of columns. These columns will be thirteen in number and will extend from their foundation below the basement line to the underside of the fifth mezzanine. They will be made up of two 15-in. channels back to back and two 20-in. plates. The spacing will be generally 14 ft. 9 in. apart, though in some cases about twice as much. A 12-in. brick wall with buff-brick finish on the engine-room side will be run up on the center line of this new row of columns to the underside of the crane, thus separating the electrical galleries from the engine-room.

In addition to the above an additional row of columns will be placed 13 ft. 6 in. south from the present columns and they will be located generally opposite the new row of columns. Thus the distance between center lines of the two new rows of columns will be 19 ft. These last-mentioned columns will be made up of four 5-in. x 3½-in. angles with a 16-in. plate between. After these alterations the average width of these mezzanines will be about 19 ft.

The main floor under the electrical galleries will be raised 6 in.; the first mezzanine, 15 in.; the second, 9 in.; the third, 14½ in.; the fourth, 15 in., and the fifth probably 30 in. The floor finish of the first, second, third and fourth mezzanines will be alberene, while the main floor under the galleries and the fifth mezzanine will have granolithic finish.

WEST-SIDE MEZZANINES.

The main alteration of the west-side mezzanines will be on the third gallery, which will be enlarged so as to accommodate the new feeder and generator control boards.

As on the south side of the building, new columns will be erected for supporting the west-side mezzanines. Four new columns made up of angles and plates will be spaced between the middle present outer wall columns and 6 in. out from their face. Likewise four of the same design will be placed on the center line of the present inside first row. Beyond the present inside second row will be two columns, 5 13/16 in. from the center line, which will run up to support cantilevers of the new bay front of control-room. There will also be another column on the center line of the present second row to support the bay front. The mezzanine will, of course, be separated from the engine-room.

The main floor under the west-side mezzanines will be raised 6 in., the first mezzanine 5 in., the second 5 in., the third 5½ in., the fourth 5 in., and the fifth 7 in. The finish of the floors will be about the same as the south-side mezzanine floors.

In further reference to the reconstruction of the third mezzanine it might be added that the bay front is necessitated by the fact that the feeder and generator control boards will be located in the shape of a horseshoe. This bay front will be constructed of wrought-iron plates on channel upright framing ornamented with wrought-iron moldings. There will be about seven plate-glass windows, thus giving from the control-board room a clear view of all parts of the engine-room floor. Over the parapet of the bay will be placed a clock with embellishment.

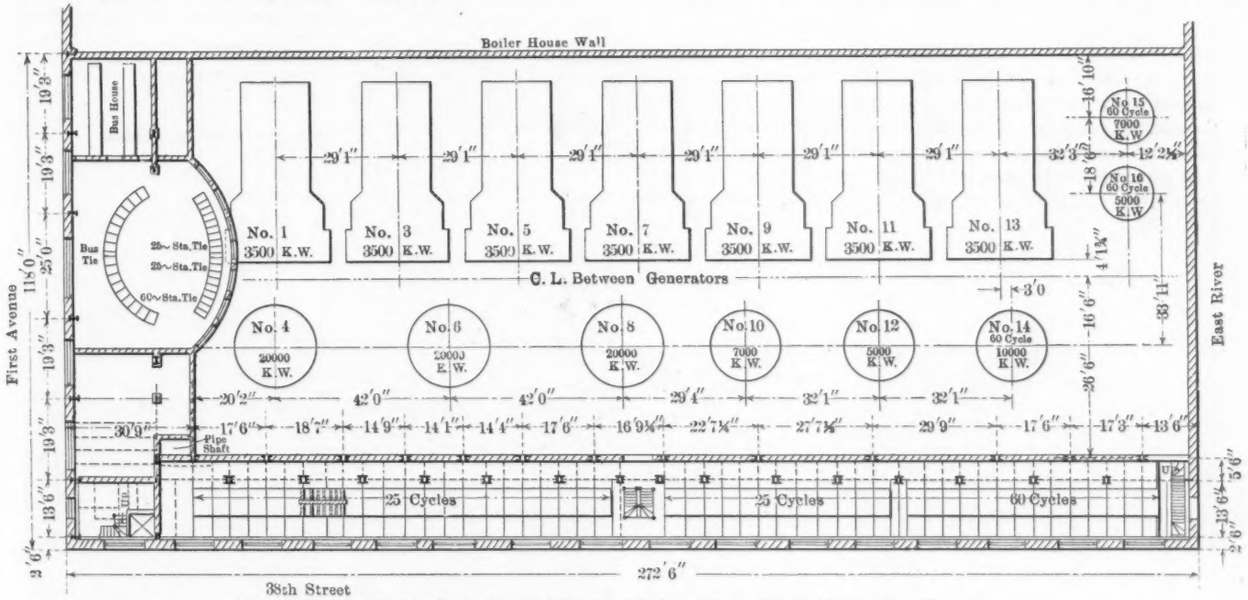


Fig. 8—Arrangement of Feeder and Generator Groups on Third Mezzanine Floor.

The average width of the west-side mezzanines will be about 28 ft. The present wind-brace walkway connecting boiler house and engine-room will, as far as bracing is concerned, be taken care of by the roof of the fourth mezzanine.

It is probable that offices will be located on these west mezzanines.

To increase further the available floor space for electrical

apparatus the present elevator shaft, located in the southwest corner of the building, will be shifted 17 ft. 6 in. west and provided with a new ornamental wrought and cast-iron inclosure. This will necessitate a reconstruction of the present entrance and lobby. The floor finish of the vestibule will be mosaic. The wainscoting will be marble, while new entrance doors of Kalamein bronze will be provided.

A new platform of concrete construction will be erected over the new elevator shaft to support the elevator machinery.

The electrical galleries on the south side will be reached by the elevator and by stairs at the east and west ends of the building. These stairs will be of new design and will extend to the fifth mezzanines. There will also be a stairway about the middle of the electrical gallery leading from the first mezzanine to the third.

The steel work has been so designed as not only to take care of additional loads due to electrical apparatus and a new oil house on the roof, but also to carry the new load due to the 110-ton crane to be installed.

UNITED ELECTRIC LIGHT & POWER COMPANY

ALTERNATING-CURRENT DISTRIBUTION IN BOROUGH OF MANHATTAN.

IT is singular yet nevertheless true that the magic name of Edison somewhat overshadows that of another New York company doing a gross business of over $2,000,000 yearly. The United Electric Light & Power Company if located in some other city would always be thought of among the large public-service companies of the country; but the influence of a well-known and well-advertised name subordinates it to some extent in the eyes of the general central-station industry, which, when thinking of New York, sees only the name of the New York Edison Company. The United Electric Light & Power Company distributes alternating current exclusively throughout the entire borough of Manhattan. This service is entirely underground, and north of 135th Street on Manhattan Island the service of this company prevails exclusively. The connected lighting load on the system is over 40,000 kw and the motor load approximates 15,000 hp. In round numbers 25,000 customers are supplied with energy from the United company's circuits.

In 1887 the company operated a single-phase, 1000-volt, 133-cycle system. The circuits were of course all overhead and the first alternating-current lighting on a commercial scale in New York City was witnessed in 1889. In 1893 the system was changed over to 60-cycle, two-phase, and subsequently the distribution system was placed underground. The three-phase, 60-cycle energy is generated in the Waterside stations, as is also 25-cycle, 6600-volt energy, and transmitted at 7500 volts and 6000 volts respectively over three-conductor, 250,000-circ. mil cables to two substations, where the 25-cycle energy is changed in frequency, phase and voltage by motor-generator sets and the 60-cycle energy transformed to two-phase energy and distributed on a three-wire system with a potential of 2100 volts between phases and 3000 volts across the outer conductors. The generating equipment of the company is located in the Waterside stations of the New York Edison Company and operated by the latter. The substations are widely separated, one being downtown on Elizabeth Street and the other being far uptown on 146th Street. A private substation is installed in the works of the National Biscuit Company, which is the largest individual user of electrical energy supplied from the company's mains. The general and executive offices of the company are located at 1170 Broadway at the corner of Twenty-eighth Street. Owing to the rapid increase in the company's business it was found necessary to maintain a branch office and showroom in the uptown district at 138 Hamilton Place, near West 143d Street and Amsterdam Avenue. This office, which was opened last September, provides accommodation for the public for the payment of bills, renewing of incandescent lamps and signing of applications. In addition a well-stocked showroom where the latest electrical devices are shown and demonstrated is an attractive feature of no small importance, as the office is in the midst of a high-class apartment-house district. The apparatus displayed is sold at retail and a demonstrator and a salesman are in constant attendance. Small devices, particularly electric flatirons, are sent out on thirty days' trial with excellent results. It is estimated that 100 are thus disposed of monthly, the greater part of which are sold to the users after the trial period has elapsed.

Fig. 1—Elizabeth Street Substation.

SUBSTATIONS.

The two substations of the company are similarly equipped except as to capacity. In the Elizabeth Street substation there are installed two 1000-kw motor generators and three sets of air-blast transformers, each set being rated at 2750 kw. The motor-generator sets are made up of 25-cycle, three-phase, 6600-volt slip-ring type motors driving 60-cycle, 2100-volt, two-phase generators. The resistors in the secondary circuit of the motors are arranged for manual or automatic operation, the

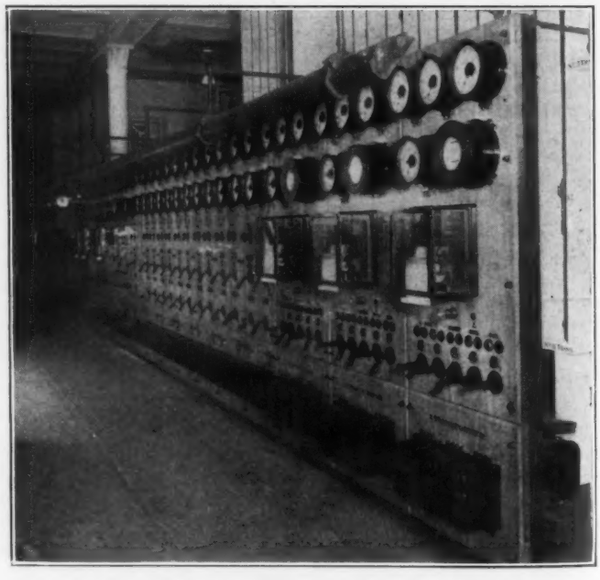


Fig. 2—Switchboard, Elizabeth Street Substation.

latter control being employed when the generators are connected in parallel with the transformer sets on the station bus. The motor-generator sets are held, however, largely in reserve for peak loads. By running the generator of the set as an over-excited synchronous motor and controlling the field circuit the sets may be employed as rotary condensers to improve the regulation of the system, and this is very often done in the uptown substation.

The transformer sets in each of the stations are made up of two 1250-kw transformers connected in parallel and one smaller transformer rated at 250 kw. The transformers are arranged in T-connection for changing from three-wire, three-phase to three-wire, two-phase. It will be noted that the small transformer has only a fraction of the output of the others because the motor load of the company is only approximately 15 per cent of the maximum load and the small transformer supplies the third or "power" leg of the system and maintains the proper phase relation for motor work. The voltage between phases is approximately 2100, but the tension across the outer conductors is 3000 volts and all the lighting load is carried single-phase across these outer conductors. This arrangement possesses advantages in that the bulk of the load is transmitted at a much higher voltage than would be the case where the lighting load fed from the phases independently. The other advantage which the arrangement has is that it is only necessary to regulate what is in effect one phase.

The switch and bus compartments in both substations are built entirely of concrete. The feeders from the Waterside station are provided with overload, inverse time-element relays and are usually operated independently. The switch panels controlling the secondary side of the transformers are provided with a power-factor indicator, voltmeter, graphic wattmeter, synchronizing lamp (operating in multiple with a synchroscope) and an ammeter in each of the three legs of the circuit. The incoming 60-cycle feeders are operated independently of the others on their own set of transformers feeding into either of the buses on the secondary side. A short cross-connecting bus is also provided on the high-tension side so as to permit any feeder to operate any of the transformer sets if necessary. A similar arrangement obtains for the 25-cycle feeders.

While there are two general station buses it is usual to operate on one, as the induction feeder regulators are connected to this bus. It is possible, however, to operate the feeder from the second bus without the induction regulators, thus permitting the regulators and all series and shunt transformers to be removed for cleaning and repairs. When the feeder is connected to the second bus there is of course no means of regulation between the bus and the feeder. A motor generator is, however, started to supply the second bus and this particular feeder, the generator being regulated to suit the voltage demands of the circuit. The feeder panels are provided with an ammeter in one of the outside legs of the circuit, a voltmeter and the usual type of overload and inverse time-element relay. Each feeder supplies its own particular district and is not in multiple with any of the adjacent feeders, either on the 3000-volt distributing side or the secondary network fed from transformers on the customers' premises. By this means the voltage on each feeder is regulated to give constant potential on the distributors, the layout of the latter being such that there is a minimum voltage drop between the feeder terminal and any point on the distributors.

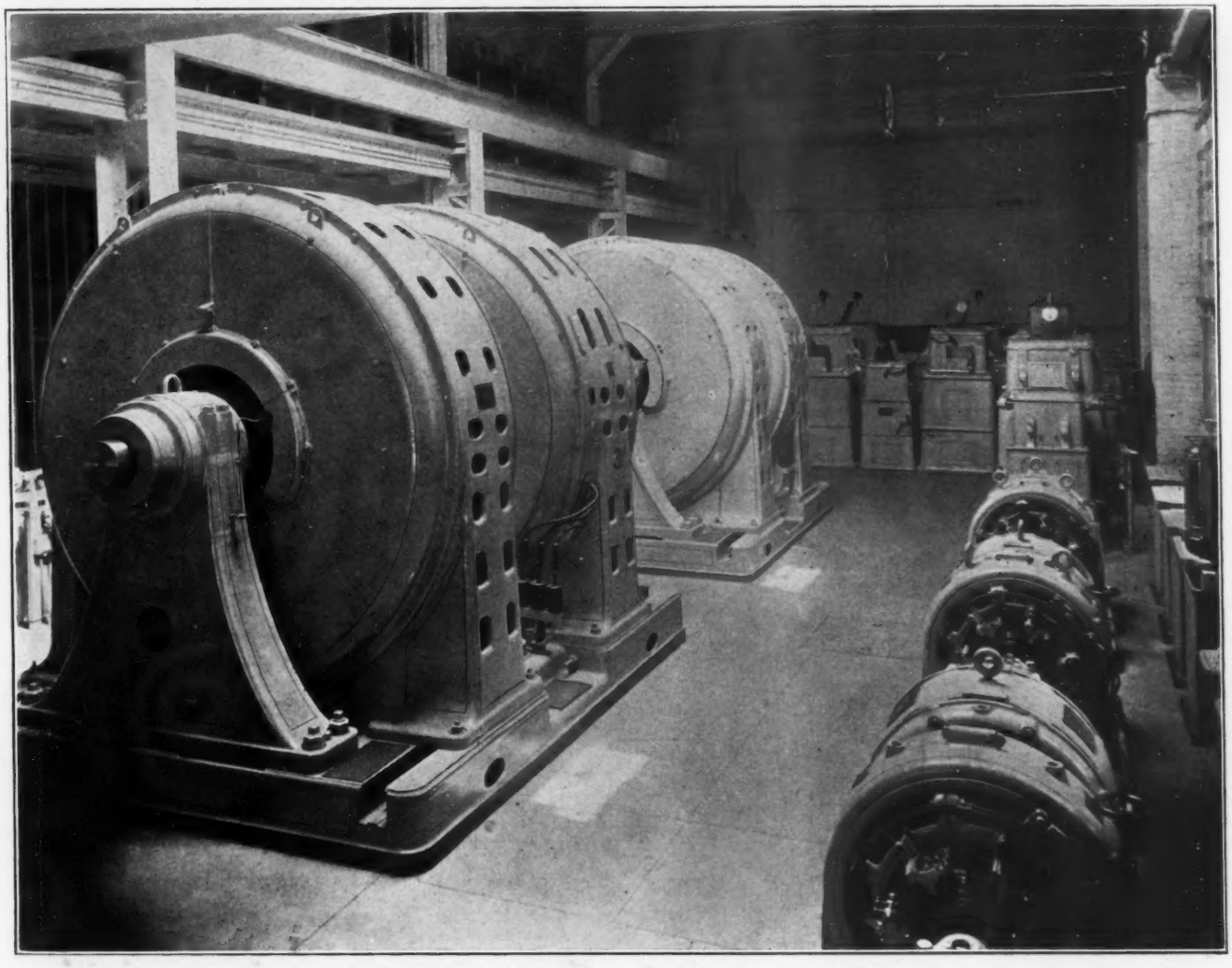


Fig. 3—General View of Equipment in 146th St. Substation.

Each feeder is controlled by an automatic induction-type Westinghouse two-phase regulator. Each regulator is of 85-kva rating and has a range of regulation of 10 per cent above or below the busbar voltage. Each regulator is operated by a

Fig. 4—Two-Phase Induction Regulator, 146th Street Substation.

220-volt, 4/10-hp Westinghouse direct-current motor controlled by regulating relays. The relays operate through voltmeter compensators so as to maintain constant voltage at the service

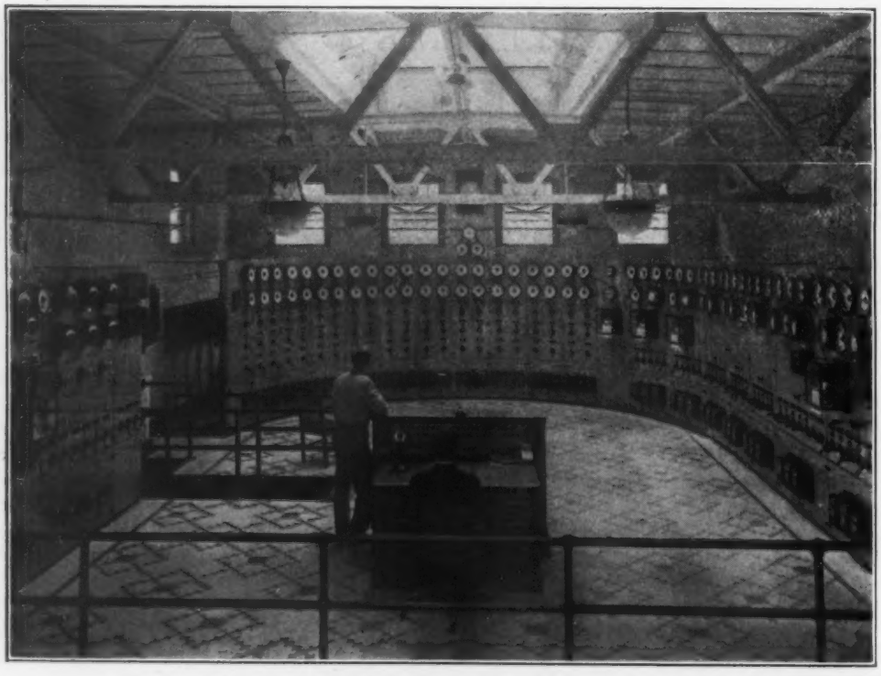


Fig. 5—Switchboard in 146th Street Substation.

end of the feeders. Each feeder has a complete equipment of compensator, relays and regulators. The results obtained are in some ways remarkable.

DISTRIBUTION.

While the system of the United Electric Light & Power Company is three-wire, two-phase, it is single-phase so far as lighting is concerned. All the lamp circuits are connected across the outer conductors as previously mentioned. For two-phase

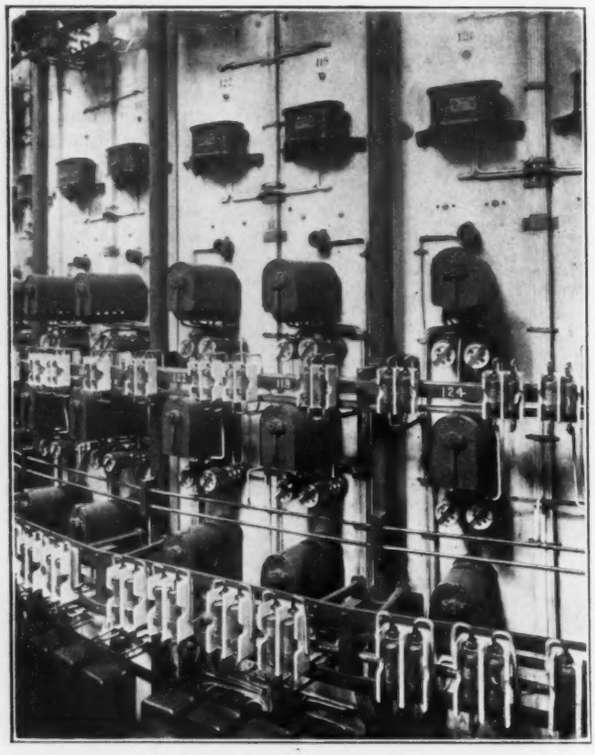


Fig. 6—Rear of Switchboard in 146th Street Substation.

motor circuits two transformers are used which are connected in the same manner as the large transformers in the substations. All transformers, whether for lamp or motor circuits, are similar; that is, the primary and the secondary are in two sections. The transformer which is connected across the 3000-volt circuit has its primary sections (1500 volts each) in series. The other transformer has its primaries connected in multiple, as the tension between the outer conductor and the middle of the main transformer is just one-half the voltage across the outers. The secondaries are connected to give 200 volts, two-phase, and while the phases are independent they are run three-wire to the motors. In this combination one-half of the motor load is also carried at the higher voltage. Where considerable energy is required by a single customer for motor circuits it is usual to install a set of transformers which feed back into the three-wire, two-phase motor secondary circuits. By this means the number of separate transformer installations necessary to supply energy to a given number of customers in a district possessing a reasonably dense business is materially reduced. The lighting network is laid out for three-wire service with 110 volts between the center and outer conductors. The three-wire mains are of single-conductor lead-covered cable, the three conductors being drawn into the same standard

subway duct. Street secondaries are tied together so as to form an interconnected network for four or five banks of transformers. On the secondary side a tap from the middle of the 200-volt secondary supplies the neutral, at which point the transformer is solidly grounded. It will be noted that the motor and lamp secondary systems are separate and distinct so that the lighting system is only remotely affected by intermittent

Fig. 7—Concrete Switch Structure at 146th Street Substation.

"power" demands such as are afforded by elevator motors, etc. The company has over 500 elevators operated from its mains, some of which are of the most recent development of switch or electrically controlled cars. Needless to state, all are fitted with alternating-current motors.

According to the regulation of the companies operating the underground conduit system in New York City, subway types of transformers have not so far been used in the manholes, and therefore the transformer installations must be made inside the

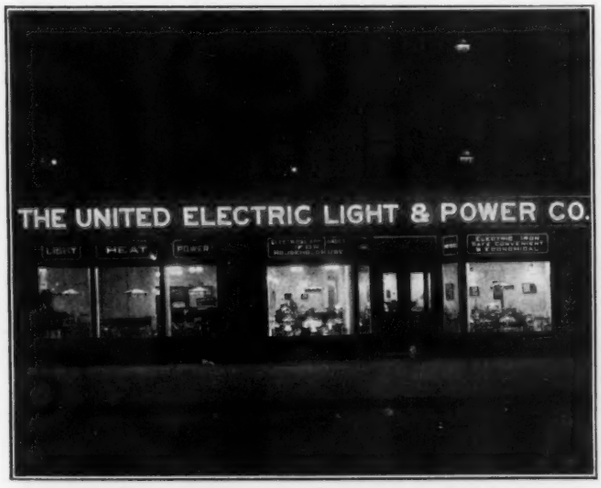


Fig. 8—Exterior of Branch Office.

curb line and on property controlled by the consumer. This naturally brings the installation within the jurisdiction of the Fire Underwriters, and the latter in turn prohibit the use of oil transformers. Consequently all the transformers for general distributing work are of the air-cooled type. The transformers are placed in a horizontal position invariably, on the floor or on some suitable support, but never bolted to the walls. The ratings of the transformers in general use range from 2 kw to 25 kw, the majority, however, being between 10 kw and 25 kw. There are, however, more 25-kw units installed than all other sizes combined. The transformers have a regulation of 1.3 per cent at unity power factor and have such characteristics that they may be used in multiple in an installation to make up whatever aggregate capacity may be required.

The distribution being entirely underground and the transformers having of necessity to be installed on customers' premises, the number of transformers is comparatively large. There are a number of reasons besides those already mentioned which contribute to this result. For instance, the rating of the transformers which can be installed in a certain location is limited, the transformers themselves must be ventilated, and considera-

Fig. 9—Branch Office Interior.

tion must be given to the facilities for handling the apparatus in the area of access available. Although a great many installations have an aggregate capacity greater than 25 kw, they are made up of a collection of units, from which it may be inferred that the iron losses are quite heavy. Offsetting these losses, however, are the low average feeder losses from the substation bus to the transformers. The company has service on 150 miles of street and occupies 320 miles of ducts with a

Fig. 10—Electrically Equipped Apartment Houses.

total of approximately 950 miles of conductors, including all classes.

SPECIAL CONSUMERS.

As an illustration of one of the special classes of consumers supplied by the United Electric Light & Power Company, mention might be made of the principal features of the installation on the property of the National Biscuit Company at

Tenth Avenue and Fifteenth Street. There are approximately 200 motors, aggregating 1500 hp, and ranging in rating from ⅛ to 150 hp, connected to the system, with a lighting equipment approximating 10,000 50-watt equivalents. An installation made up of six 200-kw, 7500-200-volt, oil-cooled transformers connected three-phase to two-phase supplies the energy for this establishment. The transformers are fed through two high-tension feeders direct from the 60-cycle bus at the Waterside station. The switches and buses are installed in concrete compartments, and the arrangement provides for the isolation of any transformer or either feeder without interrupting the service. The regulation is controlled automatically by potential regulators operating on the primary side of the transformers and having a capacity sufficient to compensate for a voltage change 10 per cent on either side of the normal. The regulators, one of which is allotted for each of two secondary buses, are oil-cooled and motor-operated, the motor being controlled by an automatic contact-making voltmeter and relays.

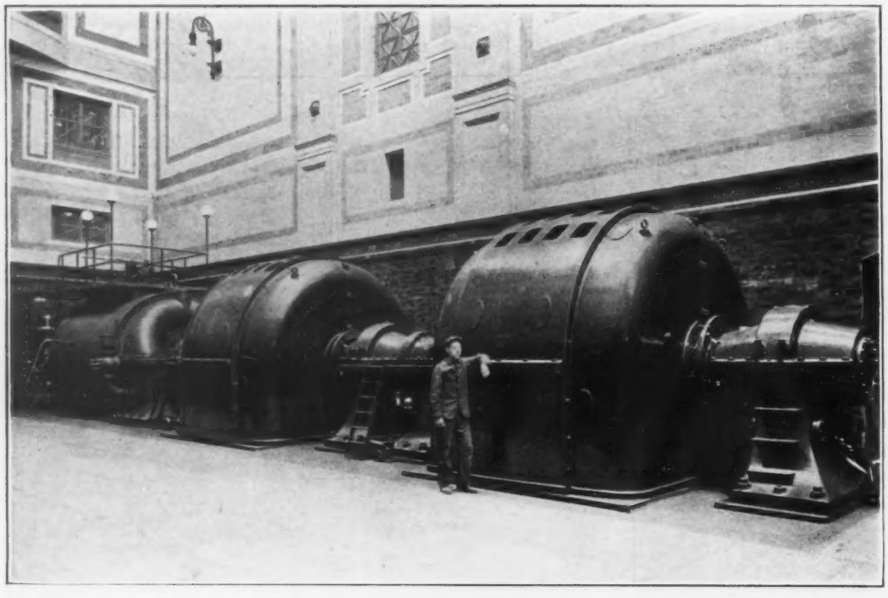


Fig. 11—Combination 25-60-Cycle Unit in Waterside Station.

RESIDENTIAL SERVICE.

An interesting feature of the growth of Manhattan Island is the rapid development in the northern section, known as Washington Heights. Ten years ago a great part of this section was undeveloped ground, with neither houses nor stores, while to-day a large fraction of the population of the borough resides in this locality. The development of the apartment-house business in this section is clearly illustrated in Fig. 12, which shows a block on upper Broadway, West 156th and 157th Streets and Riverside Drive. This block contains modern apartment houses having accommodations for 462 families in suites of from six to twelve rooms, and representing a connected load of 12,000 50-watt equivalents in lamps and 325 hp in motors for the operation of elevators, house pumps, etc. The majority of the houses in this locality use electricity exclusively as an illuminant, the records of the company showing that 85 per cent of the apartment-house dwellers use electricity for lighting and for various other purposes.

Another section of the territory worthy of mention is known as the Pinehurst section, where a high class of apartment houses is being erected and electrically equipped throughout. Fig. 15 shows the development along the Riverside Drive extending north of West 145th Street. The apartment houses shown are all equipped with electric service from the mains of the United company. The greater part of this business is secured by the active solicitation of the representatives of the company, supplemented with an elaborate follow-up system, comprising letters and attractive folders. Owing to the general popularity of electric lighting a number of apartment-house dwellers make unsolicited application to the company for its service. There are at the present time approximately 1100 apartment houses connected to the United Electric Light & Power Company's mains, one-half of which are equipped with alternating-current electric elevators.

COMMERCIAL BUSINESS.

The progress made in commercial lighting in the northern section of Manhattan Borough is well illustrated in Figs. 13 and 14, which show day and night views of St. Nicholas Avenue, looking north.

The United company's business in the lower or southern section of the borough is largely confined to store lighting and industrial applications. One of the most interesting installations connected in this section is the garage of Gimbel

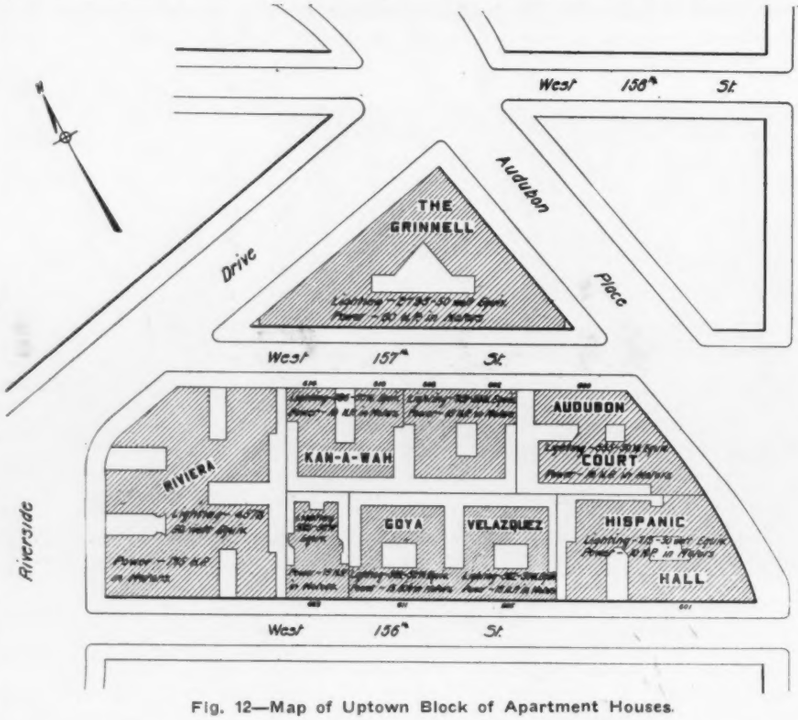


Fig. 12—Map of Uptown Block of Apartment Houses.

Brothers, which is equipped for housing and storing 150 electric vehicles. Many of the large electric signs displayed on the Great White Way are operated from the mains of the company, and a large number of the theaters and other public

Fig. 13—St. Nicholas Avenue by Day.

buildings of the city are also numbered among the customers that depend upon its service.

The company supplies energy to the city under contract for 44,648 incandescent lamps, 570 arc lamps and 248 tungsten

Fig. 14—St. Nicholas Avenue at Night.

lamps, including maintenance, and also supplies energy to 500 hp in motors belonging to the municipality.

OFFICERS.

The officers of the United Electric Light & Power Company are as follows: President, Mr. William R. Addicks; vice-

Fig. 15—Riverside Drive Apartment Houses.

president, Mr. Thomas E. Murray; secretary, Mr. Frank W. Smith; treasurer, Mr. Benjamin Whiteley; assistant secretary, Mr. L. A. Coleman; electrical engineer, Mr. W. E. McCoy; superintendent of installations, Mr. Joseph G. Swallow. Mr. Joseph F. Becker fills the position of sales manager of the company.

UNDERGROUND CONDUIT CONSTRUCTION

VARIOUS KINDS OF SUBWAY DUCTS USED IN MANHATTAN AND METHODS OF INSTALLATION.

By Edwin R. Quinby.

THE writer, who has been engaged in the work of underground electrical conduit installations for about twenty-two years, principally in New York City, has watched closely its growth and changes during that period, which practically means its entire career. The first real underground electrical work was started in the year 1886, although some "Edison tubes" and telegraph cables were buried before that time. About twenty-three years ago at a meeting of the National Electric Light Association a resolution was adopted which read somewhat as follows: "Resolved, that the scheme of placing electric-light and power cables underground is commercially inpracticable." Views have certainly changed since then, as to-day this method is the only one considered suitable.

In Table II are shown the amount and types of different underground conduits in New York City, or rather in the bor-

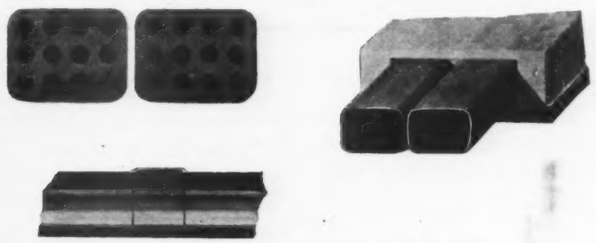


Fig. 1—Multiple-Duct Tile Conduit in Concrete.

oughs of Manhattan and the Bronx. In the other boroughs, with the exception of Brooklyn, there is very little underground conduit construction, and in Brooklyn the electric-lighting companies, as well as the railway and telephone and telegraph companies, own their own conduits, whereas in Manhattan and the Bronx subway companies rent the conduits.

In the construction of conduits in the borough of Manhattan more different kinds of subsurface structures are encountered than probably in any other city in the world. There are gas mains and branches; water mains and branches for both high and low pressure; steam mains and branches; pneumatic tubes; sewers and culverts; telegraph conduits; electricity supply conduits, including conduits for the underground and elevated rail-

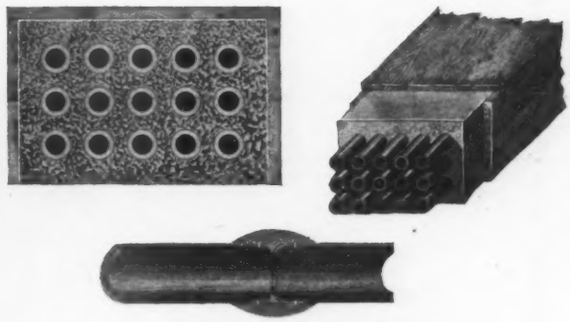


Fig. 2—Fiber Conduit in Concrete.

roads and street-car lines; Edison tubes; the subway tunnel; the McAdoo tunnel; the Croton aqueduct, and many new or contemplated structures and building operations. In fact, in New York improvements are always being made, so that the care and maintenance of existing subsurface structures is a difficult task, particularly as at varying depths there is nothing

TABLE I.—ESTIMATE OF COST PER TRENCH FOOT OF ELECTRICAL SUBWAY BASED UPON CONSTRUCTION IN NEW YORK CITY.

WROUGHT-IRON PIPE LAID IN CONCRETE AND PROTECTED BY CREOSOTED WOOD

SUBWAY.		DETAIL STATEMENT OF COST, LABOR AND MATERIAL IN FRACTIONS OF DOLLAR.																													
		COST OF LABOR.													Includes Labor & Material.		COST OF MATERIAL.							GRAND TOTAL,		Center to Center Distance in Feet Between Boxes and Between Manholes.	Dimensions of Trench in Inches Less 8 Inches for Paving.	NUMBER AND ARRANGEMENT OF DUCTS.				
							Repaving.		Repairs to Pavement for 1 Year.									Concrete													
Number and Diameter in Inches.	Character.	Trench.	Boxing and Bracing.	Concrete.	Pipe Work.	Carting	Dump.	Belgian Block.	Special Block.	Belgian Block.	Special Block.	Outside Superintendence.	Engineering and Office.	Total Belgian Block.	Total Special Block.	Boxes.	Manholes.	Pipe 3 In.	Sand and Stone.	Cement.	Black Plank.	Spruce.	Incidentals.	Total.	Belgian Block.	Special Block.			Number of Ducts.	Number of Rows.	Ducts in Row.	Number of Rows.	Ducts in Row.
1–3	Distributing	.100	Laid bare		.020	.060	.010	.110	.150	.040	.060	.138	.029	.507	.567	.568	..	.180	Laid bare		..	..	.040	.788	1.295	1.355	Boxes 55	16x26	1	1	1	..	..
2	"	.142	.015	.016	.045	.125	.035	.135	.173	.050	.086	.165	.030	.758	.832	.568	..	.360	.020	.034	.175	.010	.050	1.217	1.975	2.049	" "	20x30	2	1	2	..	..
3	"	.175	.020	.022	.063	.130	.040	.158	.206	.065	.103	.170	.030	.873	.959	.568	..	.540	.035	.058	.235	.015	.060	1.511	2.384	2.470	" "	26x30	3	1	3	..	..
4	"	.196	.022	.028	.080	.145	.048	.175	.227	.085	.113	.192	.035	1.006	1.086	.568	..	.720	.042	.071	.262	.018	.065	1.746	2.752	2.832	" "	30x30	4	2	2	..	..
4	Trunk	.220	.040	.034	.050	.142	.045	.175	.227	.085	.113	.194	.035	1.020	1.100	..	.384	.720	.067	.115	.140	.022	.070	1.518	2.538	2.618	M'holes 260	26x35	4	2	2	..	..
5	"	.220	.040	.040	.060	.180	.055	.175	.227	.085	.113	.196	.035	1.086	1.166	..	.384	.900	.081	.138	.175	.025	.070	1.773	2.859	2.939	" "	26x35	5	1	2	1	3
6	"	.245	.040	.040	.078	.185	.060	.180	.227	.085	.113	.200	.035	1.148	1.223	..	.384	1.080	.078	.134	.115	.030	.070	1.891	3.039	3.114	" "	35x35	6	2	3	..	..
7	"	.305	.040	.060	.085	.205	.065	.195	.265	.090	.120	.250	.040	1.335	1.435	..	.420	1.260	.090	.157	.140	.035	.075	2.177	3.512	3.612	" "	36x35	7	1	3	1	4
8	"	.305	.040	.055	.100	.210	.065	.195	.265	.090	.120	.260	.040	1.360	1.460	..	.420	1.440	.085	.155	.140	.035	.075	2.350	3.710	3.810	" "	36x35	8	2	4	..	..
9	"	.300	.040	.070	.105	.220	.080	.180	.227	.085	.113	.280	.045	1.405	1.480	..	.450	1.620	.118	.204	.115	.040	.075	2.622	4.027	4.102	" "	30x40	9	3	3	..	..
10	"	.350	.040	.065	.110	.230	.085	.195	.265	.090	.120	.320	.050	1.535	1.635	..	.450	1.800	.104	.195	.140	.040	.080	2.809	4.344	4.444	" "	36x40	10	1	4	2	3
		CAMP TILE CONDUIT LAID IN CONCRETE AND PROTECTED BY CREOSOTED WOOD.																													
4–3	Trunk	.280	.040	.050	.090	.160	.065	.195	.265	.090	.120	.360	.040	1.370	1.470	..	.384	.240	.065	.070	.140	.035	.065	.999	2.369	2.469	M'holes 260	30x36	4	1	4	..	..
6	"	.300	.040	.060	.110	.200	.080	.180	.227	.085	.113	.390	.040	1.485	1.560	..	.384	.360	.073	.082	.115	.040	.070	1.124	2.609	2.684	" "	25x42	6	2	3	..	..
8	"	.325	.045	.068	.145	.215	.088	.195	.265	.090	.120	.415	.045	1.631	1.731	..	.420	.480	.076	.084	.140	.040	.075	1.315	2.946	3.046	" "	30x42	8	2	4	..	..
10	"	.405	.065	.090	.175	.230	.095	.195	.265	.090	.120	.450	.048	1.833	1.933	..	.450	.600	.095	.120	.140	.045	.080	1.530	3.363	3.463	" "	30x46	10	2	4	1	2
12	"	.405	.065	.095	.200	.270	.092	.195	.265	.090	.120	.480	.050	1.942	2.042	..	.500	.720	.110	.145	.140	.058	.090	1.763	3.705	3.805	" "	30x46	12	3	4	..	..
14	"	.460	.065	.120	.235	.310	.100	.227	.280	.095	.125	.540	.055	2.207	2.290	..	.500	.840	.140	.180	.175	.080	.100	2.015	4.222	4.305	" "	36x46	14	2	5	1	4
16	"	.475	.065	.135	.260	.330	.120	.195	.265	.090	.120	.580	.060	2.310	2.410	..	.520	.960	.150	.190	.140	.080	.100	2.140	4.450	4.550	" "	32x51	16	4	4	..	..
18	"	.525	.070	.150	.295	.375	.138	.227	.280	.095	.125	.640	.070	2.585	2.668	..	.520	1.080	.165	.215	.175	.116	.100	2.371	4.956	5.039	" "	36x51	18	3	5	1	3
20	"	.615	.070	.175	.315	.405	.165	.227	.280	.095	.125	.675	.075	2.817	2.900	..	.520	1.200	.160	.220	.175	.128	.100	2.503	5.320	5.403	" "	38x56	20	4	5	..	..
22	"	.615	.070	.180	.325	.420	.160	.227	.280	.095	.125	.680	.075	2.847	2.930	..	.520	1.320	.175	.235	.175	.128	.100	2.653	5.550	5.583	" "	38x56	22	4	5	1	2
24	"	.625	.070	.202	.350	.450	.173	.260	.292	.113	.135	.720	.080	3.043	3.097	..	.520	1.440	.184	.250	.175	.134	.100	2.803	5.846	5.900	" "	43x51	24	4	6	..	..
26	"	.625	.070	.215	.370	.455	.170	.260	.292	.113	.135	.730	.080	3.088	3.142	..	.550	1.560	.196	.285	.175	.134	.110	3.010	6.098	6.152	" "	43x56	26	4	6	1	2
28	"	.620	.070	.230	.385	.465	.181	.287	.320	.120	.140	.760	.085	3.203	3.256	..	.550	1.680	.205	.300	.203	.150	.110	3.198	6.401	6.454	" "	45x51	28	4	7	..	..
30	"	.625	.080	.250	.400	.475	.190	.260	.292	.113	.135	.800	.085	3.278	3.332	..	.550	1.800	.220	.325	.175	.158	.110	3.338	6.616	6.670	" "	43x56	30	5	6	..	..
32	"	.690	.080	.260	.415	.520	.220	.287	.320	.120	.140	.815	.090	3.497	3.550	..	.580	1.920	.230	.335	.203	.166	.110	3.544	7.041	7.094	" "	45x56	32	4	7	1	4
34	"	.690	.080	.280	.435	.525	.215	.287	.320	.120	.140	.830	.090	3.552	3.605	..	.580	2.040	.250	.350	.203	.166	.110	3.699	7.251	7.304	" "	45x56	34	4	7	1	6
36	"	.726	.085	.300	.450	.540	.230	.310	.335	.125	.145	.875	.095	3.736	3.781	..	.580	2.160	.270	.380	.203	.190	.110	3.893	7.629	7.674	" "	49x56	36	4	8	1	4
38	"	.726	.085	.300	.470	.570	.230	.310	.335	.125	.145	.880	.095	3.791	3.836	..	.580	2.280	.270	.390	.203	.190	.110	4.023	7.814	7.859	" "	49x56	38	4	8	1	6
40	"	.726	.085	.305	.485	.585	.225	.310	.335	.125	.145	.900	.098	3.844	3.889	..	.600	2.400	.275	.405	.203	.206	.110	4.199	8.043	8.088	" "	49x56	40	5	8	..	..
42	"	.735	.085	.310	.495	.590	.235	.310	.335	.125	.145	.920	.100	3.905	3.950	..	.600	2.520	.285	.415	.203	.210	.110	4.343	8.248	8.293	" "	49x61	42	5	8	1	2
44	"	.735	.085	.310	.505	.590	.235	.310	.335	.125	.145	.930	.100	3.925	3.970	..	.600	2.640	.280	.410	.203	.210	.110	4.453	8.378	8.423	" "	49x61	44	5	8	1	4

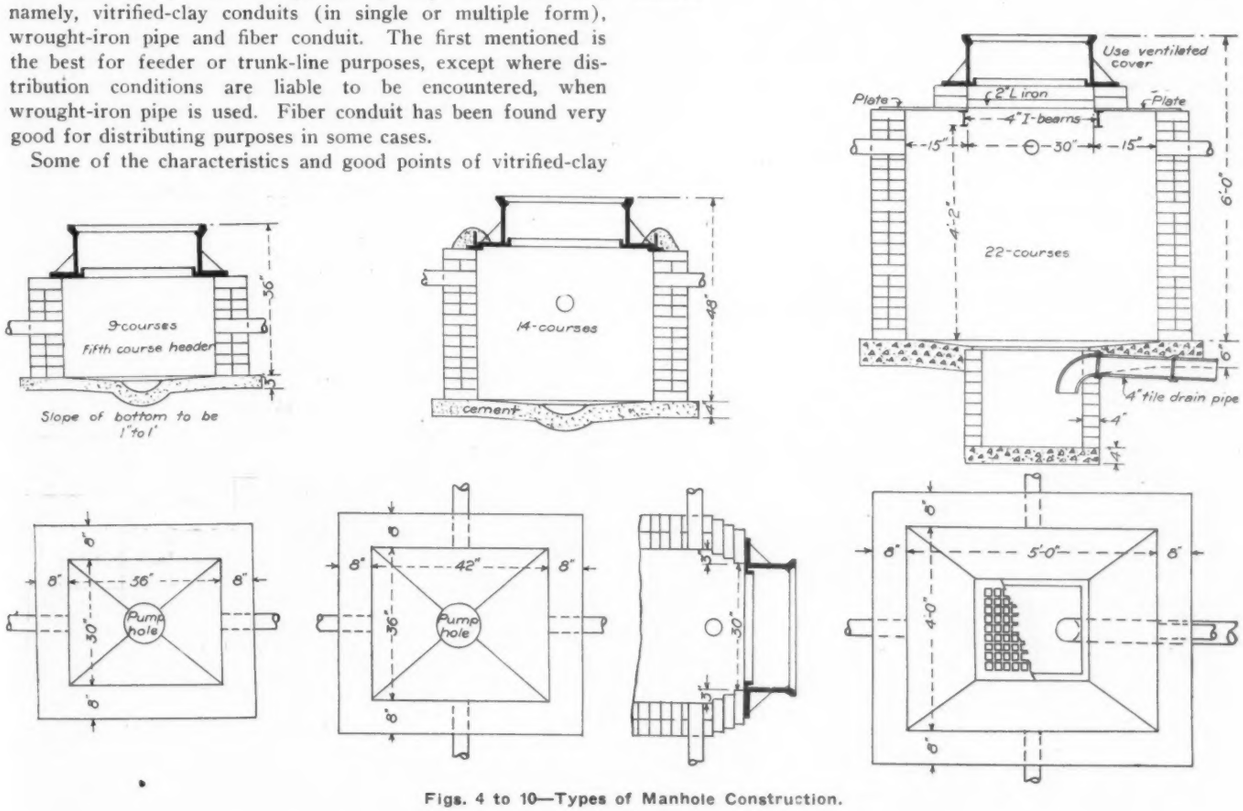
more or less than a solid-rock stratum. Many of the structures rest on solid rock and great care must be taken in going underneath them, the rock being either wedged out or blasted out with very light charges of powder.

The Consolidated Telegraph & Electrical Subway Company, which builds most of the conduits for electric-lighting and motor service, makes most of its rock excavations by means of air drills receiving air from portable compressors, which in turn are operated by electric motors. This means of rock excavation has proved very economical.

Fig. 3—Chain-Driven and Directly Connected Motor-Operated Air Compressors.

Many different types of conduits have been experimented with, until to-day there are practically only three standards, namely, vitrified-clay conduits (in single or multiple form), wrought-iron pipe and fiber conduit. The first mentioned is the best for feeder or trunk-line purposes, except where distribution conditions are liable to be encountered, when wrought-iron pipe is used. Fiber conduit has been found very good for distributing purposes in some cases.

Some of the characteristics and good points of vitrified-clay conduit are: It is a natural product of the earth and there are practically no deteriorating effects from placing it in the earth. It is electrolysis-proof. It is a very poor conductor of heat and also of electricity. It is practically imperishable if not subjected to mechanical injury. Acids, dampness and gases have no deteriorating effects on it. Its glazed surface facilitates the drawing in and out of cables, and it is not in any way injured thereby when properly laid. When laid in sufficiently large amount—that is, in a large number of ducts—it forms a rigid mass that is not easily injured by being disturbed from outside causes. It is economical to use. Lengths of these conduits from 1.5 ft. to 3 ft. long have been tested for resistance to high-voltage arcs (puncture test) to about 30,000 volts, and the arc runs around the ends, showing them to be practically puncture proof when well glazed, vitrified and free from metallic substances.



Figs. 4 to 10—Types of Manhole Construction.

Fiber conduit is electrolysis-proof and is a very poor conductor of heat and electricity. After being laid it is accessible for distribution purposes, it being an easy matter to cut in branch-service boxes.

Vitrified clay is far superior to fiber for ordinary electrical conduit construction other than distribution purposes. It is more durable and much more acid and gas-proof and it withstands the wear of drawing in and out better. It will withstand burn-outs, short-circuits, punctures, etc., much better.

Fiber conduit has been used in outlying districts for branches and distribution lines with good results, but its durability and powers of resistance to action of acids and gases are somewhat doubtful, concerning which vitrified-clay conduit has proved through years of constant use its great superiority.

A series of puncture tests made under the supervision of the writer showed that fiber conduit, when perfectly dry, punctures at 27,466 volts, and after immersion in water for twenty-four hours it punctures at 17,100. The puncture is clean and sharp. This is a fairly good result, but is greatly inferior to that with vitrified-clay conduit.

The writer prefers to use vitrified-clay conduit for all trunk-line work, and to use some fiber conduit for distribution purposes on account of its accessibility.

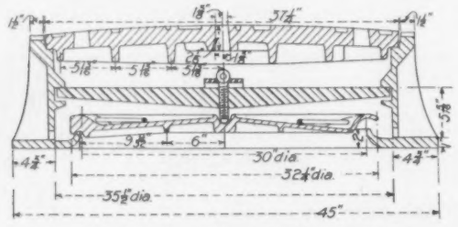


Fig. 11—Details of Large Manhole Cover.

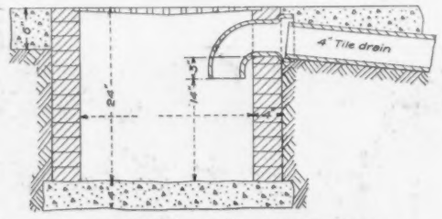


Fig. 12—Details of Manhole Drainage.

Cable-splicing service boxes and manholes used for distribution are shown in Figs. 4 to 10.

The I-beams, plates, etc., in manholes should be protected as much as possible with concrete to prevent oxidation.

A considerable number of methods of ventilation for electrical subways have been tried in New York City during the past

TABLE II.—TYPES AND LENGTH IN FEET OF ELECTRIC LIGHT, TELEPHONE AND TELEGRAPH CONDUIT CONSTRUCTION IN NEW YORK CITY.

COMPANY.	WROUGHT-IRON PIPE.							CASING PIPE.
	1.5 In.	2.0 In.	2.5 In.	3.0 In.	3.5 In.	4.0 In.	4.5 In.	3.0 In.
C. T. & E. S.	33,479.92	10,922.58	97,805.06	6,612,183.97	329,478.65	188,919.75	.....	.....
Edison	.....	2,227.02	12,577.76	333,605.45	73,906.98	35,590.26	5,504.69	.....
Empire	.....	45,042.20	2,123,073.21	2,858,251.76	.....	9,359.60	.....	5,012.50
Total	33,479.92	58,191.80	2,233,456.03	9,804,041.18	403,385.63	233,869.61	5,504.69	5,012.50

COMPANY.	KALAMEINED PIPE.		FIBER.			REILLY.	BROOKS.	CEMENT-LINED.	
	2.5 In.	3.0 In.	3.0 In.	3.5 In.	4.0 In.	4.0 In.	3.0 In.	2.5 In.	3.0 In.
C. T. & E. S.	.....	.....	183,597.60	1,844.40	48,634.30	.....	.....	.....	118,652.17
Edison	.....	.....	.....	.....	.....	.....	.....	.....	.....
Empire	133,812.64	30,376.92	.....	.....	.....	855.15	49,714.38	350,683.79	.....
Total	133,812.64	30,376.92	183,597.60	1,844.40	48,634.30	855.15	49,714.38	350,683.79	118,652.17

COMPANY.	EDISON THREE-WIRE TUBE.						ZINC.	CREOSOTE WOOD BOX.		
	1 In.	1.25 In.	1.5 In.	2.0 In.	2.5 In.	3 In.	2.5 In.	2.5 In.	3.0 In.	4.0 In.
C. T. & E. S.	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....
Edison	9,438.64	54,086.98	4,059.16	547,362.95	129,281.15	141,221.45	.....	.....	.....	.....
Empire	.....	....	.....	.....	.....	.....	32,880.00	330.12	410.40	358.40
Total	9,438.64	54,086.98	4,059.16	547,362.95	129,281.15	141,221.45	32,880.00	330.12	410.40	358.40

COMPANY.	WYCKOFF.	DORSET.	SAND BOX.		TILE.	JOHNSTONE.		Grand Totals.	Manholes.	Service Boxes.
	2.5 In.	2.5 In.	1.25 In.	2.0 In.	3.0 In. to 3.5 In.	A.	C.			
C. T. & E. S.	.....	.....	.....	.....	8,180,317.64	127,183.20	48,336.24	15,981,355.48	3,517	27,565
Edison	.....	.....	5,173.48	93,653.70	61,480.68	.....	.....	1,509,170.35	273	3,388
Empire	143,789.82	42,947.76	.....	.....	10,722,058.52	.....	.....	16,548,957.17	3,945	1,207
Total	143,789.82	42,947.76	5,173.48	93,653.70	18,963,856.84	127,183.20	48,336.24	34,039,483.00	7,735	32,160

twenty-two years. Two of these are worthy of mention as failures, namely, the erection of stand pipes connected with manholes and the use of pressure blowers for forcing air through specially laid tubes with small openings in them where they pass through manholes for the purpose of maintaining an air pressure to keep out explosive gases, the entire system being closed.

Experience and investigation showed the latter to be not only

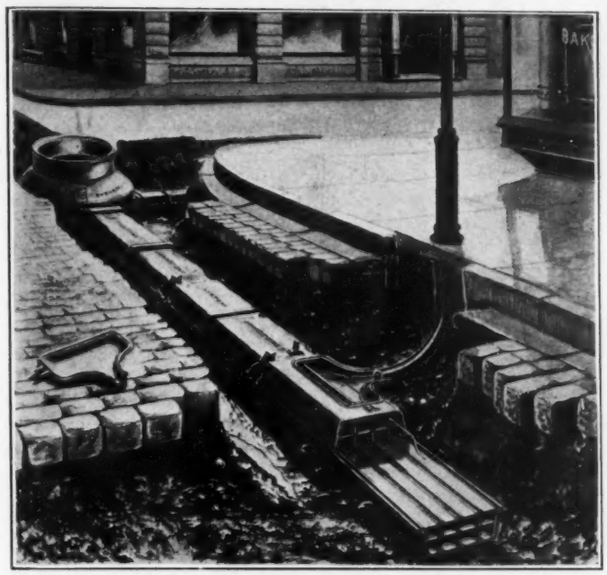


Fig. 13—Johnstone Conduit System.

a dismal failure, but also a very expensive system. Although large-sized and numerous blowers were installed, the pressure maintained in the system was insufficient except in the immediate vicinity of the blower stations. When manholes were opened for the purpose of working on the cables, etc., the pressure was, of course, removed for the time being, and much time elapsed before the pressure was fully restored after closing the manholes. The manhole castings were then provided with an inner and an outer or street cover. The inner cover was

Fig. 14—Tile Conduit.

equipped with a rubber gasket to render it air-tight and water-tight and it was also locked in its place by a bar provided with a saddle and padlock, it being deemed advisable to keep the manholes under lock and key.

In the present system of ventilation, the manholes are secured, not with lock and key, but with a seal consisting of a porcelain disk about 1.5 in. in diameter which has proved very effective and economical. The inner cover has been raised 1 in. above its seat by means of lugs placed at three points of its periphery. The outer or street cover is provided with twenty-four holes 1.5 in. in diameter at the top and 1.75 in. at the bottom to prevent accumulation of dirt and consequent stopping them up; thus there are an opening of 42 sq. in. for the escape of gas in the outer cover and an opening of 95 sq. in. around the periphery of the inner cover.

In order to prove that these conditions provided good ventilation samples of gas were taken, first, from a manhole with the solid cover on it and then from the same manhole provided with ventilating covers. Although the percentage of gas in the first place was quite large, in the second case it was hardly perceptible. All of the numerous experiments made pointed to the value of this system. The difference in temperature of the air in the manholes and the atmosphere, which always exists to some extent, is sufficient to create a good circulation.

In draining manholes to sewers care should always be taken that the drain pipe is properly tapped, not so much on account of the danger of the sewer gas exploding as because of its sickening effect on the men at work in the manholes. Sewer gas is not usually regarded as explosive, although one of its constituents, marsh gas, forms an explosive mixture with air. The other gases going to make up what is commonly called sewer gas are carbon monoxide, carbon dioxide, hydrogen sulphide, ammonia, ammonium carbonate and sulphate, and various hydrocarbon compounds. These gases are not particularly poisonous in the proportions usually found, but they have a sickening effect on the inhaler.

It is extremely important that subsidiary pipes or laterals be carefully sealed at the ends, whether entering building vaults or extending up lamp-posts. Some of the so-called gas explosions in manholes have really been simply explosions from the sudden expansion of air and vapor caused by the force and heat of "burn-outs" on cables, and in some cases by the generation of water-gas caused by the heat of the "burn-out," and hence the prevention of burn-outs on circuits is a very important preventive of explosions. In general, the latest practices for prevention of explosion of lighting and sewer gas in conduits are as follows:

Provide the manholes with ventilating covers, as described. Keep the openings of these covers clean. Keep the manholes as clean as possible and as free from water and dampness as

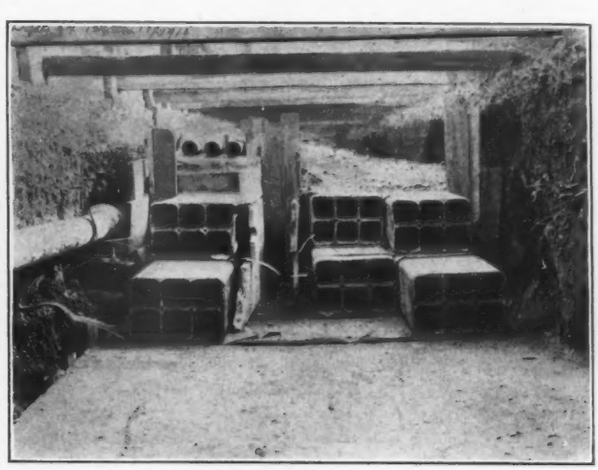


Fig. 15—Tile Conduit.

possible. Seal up the subsidiaries and laterals carefully at the ends. Have the sewer drains well trapped. Keep the gas mains in the vicinity of conduits in good repair. Keep the gas mains as far away from conduits and manholes as possible. Take all possible precaution against burn-outs. Protect the conduit and cables from mechanical injuries caused by other excavations.

Vitrified clay is far superior to fiber for ordinary electrical conduit construction other than distribution purposes. It is more durable and much more acid and gas-proof and it withstands the wear of drawing in and out better. It will withstand burn-outs, short-circuits, punctures, etc., much better.

Fiber conduit has been used in outlying districts for branches and distribution lines with good results, but its durability and powers of resistance to action of acids and gases are somewhat doubtful, concerning which vitrified-clay conduit has proved through years of constant use its great superiority.

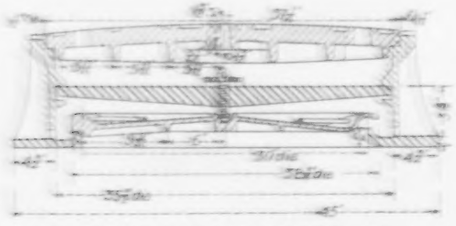


Fig. 11—Details of Large Manhole Cover.

A series of puncture tests made under the supervision of the writer showed that fiber conduit, when perfectly dry, punctures at 27,000 volts, and after immersion in water for twenty-four hours it punctures at 17,100. The puncture is clean and sharp. This is a fairly good result, but is greatly inferior to that with vitrified-clay conduit.

The writer prefers to use vitrified-clay conduit for all trunk-line work, and to use some fiber conduit for distribution purposes on account of its accessibility.

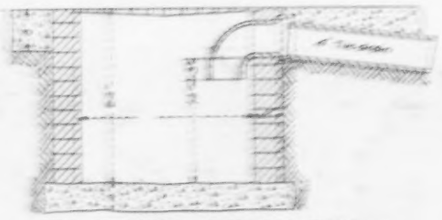


Fig. 12—Details of Manhole Drainage.

Cable-splicing service boxes and manholes used for distribution are shown in Figs. 4 to 10.

The I-beams, plates, etc., in manholes should be protected as much as possible with concrete to prevent oxidation.

A considerable number of methods of ventilation for electrical subways have been tried in New York City during the past

TABLE II.—TYPES AND LENGTH IN FEET OF ELECTRIC LIGHT, TELEPHONE AND TELEGRAPH CONDUIT CONSTRUCTION IN NEW YORK CITY.

COMPANY.	WROUGHT-IRON PIPE.							CASING PIPE.
	1.5 In.	2.0 In.	2.5 In.	3.0 In.	3.5 In.	4.0 In.	4.5 In.	5.0 In.
C. T. & E. Co.	81,470.02	10,922.58	97,803.06	1,612,183.97	329,476.65	188,919.75	.....	.....
Edison	.....	2,227.02	12,571.76	333,605.45	73,906.98	35,590.20	1,504.69	.....
Empire	.....	40,042.20	2,122,073.21	2,858,251.76	.....	9,350.60	.....	3,012.50
Total	81,470.02	53,191.80	2,232,456.03	4,804,041.18	403,383.63	233,860.61	1,504.69	3,012.50

COMPANY.	GALVANIZED PIPE.		FIBER.			REILLY.	BROOKS.	CEMENT-LINED.	
	2.5 In.	3.0 In.	3.0 In.	3.5 In.	4.0 In.	4.0 In.	3.0 In.	2.5 In.	3.0 In.
C. T. & E. Co.	.....	.....	183,507.60	1,844.40	48,634.30	.....	.....	.....	118,632.17
Edison	.....	.....	.....	.....	.....	.....	.....	.....	.....
Empire	132,812.64	30,370.02	.....	.....	.....	855.15	40,714.38	330,683.79	.....
Total	132,812.64	30,370.02	183,507.60	1,844.40	48,634.30	855.15	40,714.38	330,683.79	118,632.17

COMPANY.	EDISON THREE-WIRE TUBE.						ZINC.	CREOSOTE WOOD BOX.		
	1 In.	1.25 In.	1.5 In.	2.0 In.	2.5 In.	3 In.	2.5 In.	2.5 In.	3.0 In.	4.0 In.
C. T. & E. Co.	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....
Edison	9,438.64	54,086.90	4,050.16	547,362.95	129,281.15	141,221.45	.....	.....	.....	.....
Empire	.....	.....	.....	.....	.....	.....	32,880.00	330.12	410.40	358.40
Total	9,438.64	54,086.90	4,050.16	547,362.95	129,281.15	141,221.45	32,880.00	330.12	410.40	358.40

COMPANY.	WYCKOFF.	DORSET.	SAND BOX.		TILE.	JOHNSTONE.		Grand Totals.	Manholes.	Service Boxes.
	2.5 In.	2.5 In.	1.25 In.	2.0 In.	3.0 In. to 3.5 In.	A.	C.			
C. T. & E. Co.	.....	.....	.....	.....	8,180,317.64	127,183.20	48,336.24	15,981,355.48	3,517	27,30
Edison	.....	.....	2,170.48	93,655.70	61,480.68	.....	.....	1,568,170.35	273	2,38
Empire	141,780.82	42,947.76	.....	.....	10,722,056.52	.....	.....	16,548,957.17	3,985	3,20
Total	141,780.82	42,947.76	2,170.48	93,655.70	18,963,850.84	127,183.20	48,336.24	34,039,483.00	7,775	32,90

twenty-two years. Two of these are worthy of mention as failures, namely, the erection of stand pipes connected with manholes and the use of pressure blowers for forcing air through specially laid tubes with small openings in them where they pass through manholes for the purpose of maintaining an air pressure to keep out explosive gases, the entire system being closed.

Experience and investigation showed the latter to be not only

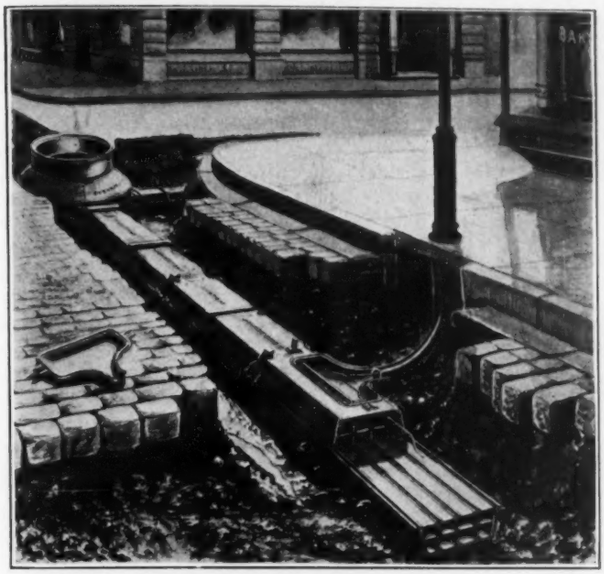


Fig. 13—Johnstone Conduit System.

a dismal failure, but also a very expensive system. Although large-sized and numerous blowers were installed, the pressure maintained in the system was insufficient except in the immediate vicinity of the blower stations. When manholes were opened for the purpose of working on the cables, etc., the pressure was, of course, removed for the time being, and much time elapsed before the pressure was fully restored after closing the manholes. The manhole castings were then provided with an inner and an outer or street cover. The inner cover was

Fig. 14—Tile Conduit.

equipped with a rubber gasket to render it air-tight and water-tight and it was also locked in its place by a bar provided with a saddle and padlock, it being deemed advisable to keep the manholes under lock and key.

In the present system of ventilation, the manholes are secured, not with lock and key, but with a seal consisting of a porcelain disk about 1.5 in. in diameter which has proved very effective and economical. The inner cover has been raised 1 in. above its seat by means of lugs placed at three points of its periphery. The outer or street cover is provided with twenty-four holes 1.5 in. in diameter at the top and 1.75 in. at the bottom to prevent accumulation of dirt and consequent stopping them up; thus there are an opening of 42 sq. in. for the escape of gas in the outer cover and an opening of 95 sq. in. around the periphery of the inner cover.

In order to prove that these conditions provided good ventilation samples of gas were taken, first, from a manhole with the solid cover on it and then from the same manhole provided with ventilating covers. Although the percentage of gas in the first place was quite large, in the second case it was hardly perceptible. All of the numerous experiments made pointed to the value of this system. The difference in temperature of the air in the manholes and the atmosphere, which always exists to some extent, is sufficient to create a good circulation.

In draining manholes to sewers care should always be taken that the drain pipe is properly tapped, not so much on account of the danger of the sewer gas exploding as because of its sickening effect on the men at work in the manholes. Sewer gas is not usually regarded as explosive, although one of its constituents, marsh gas, forms an explosive mixture with air. The other gases going to make up what is commonly called sewer gas are carbon monoxide, carbon dioxide, hydrogen sulphide, ammonia, ammonium carbonate and sulphate, and various hydrocarbon compounds. These gases are not particularly poisonous in the proportions usually found, but they have a sickening effect on the inhaler.

It is extremely important that subsidiary pipes or laterals be carefully sealed at the ends, whether entering building vaults or extending up lamp-posts. Some of the so-called gas explosions in manholes have really been simply explosions from the sudden expansion of air and vapor caused by the force and heat of "burn-outs" on cables, and in some cases by the generation of water-gas caused by the heat of the "burn-out," and hence the prevention of burn-outs on circuits is a very important preventive of explosions. In general, the latest practices for prevention of explosion of lighting and sewer gas in conduits are as follows:

Provide the manholes with ventilating covers, as described. Keep the openings of these covers clean. Keep the manholes as clean as possible and as free from water and dampness as

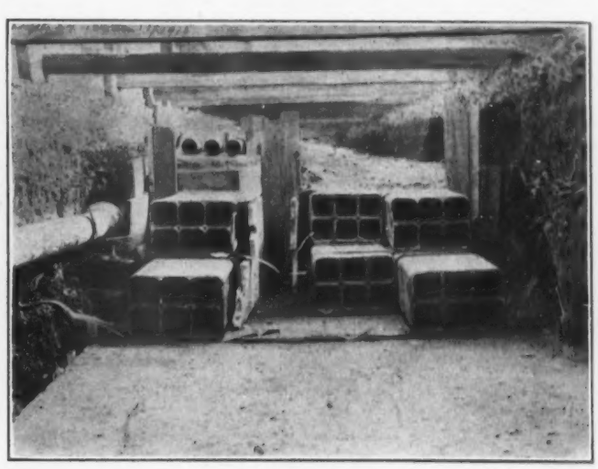


Fig. 15—Tile Conduit.

possible. Seal up the subsidiaries and laterals carefully at the ends. Have the sewer drains well trapped. Keep the gas mains in the vicinity of conduits in good repair. Keep the gas mains as far away from conduits and manholes as possible. Take all possible precaution against burn-outs. Protect the conduit and cables from mechanical injuries caused by other excavations.

NEW YORK BY NIGHT

GENERAL ILLUMINATION OF MANHATTAN BOROUGH AND DESCRIPTION OF ELECTRIC SIGNS

THE metropolis of the Western Hemisphere possesses a charm peculiarly its own which springs into being with every setting sun. It would seem that with the approaching darkness every available roof, wall and fence becomes a beacon, and the hurry and bustle of the New York day dwindle away in the gay and merry laughter of its night. This is especially true of the "Great White Way," concerning which a great deal has been written. The bewildering confusion of electric signs, with their white and colored lights, some motionless, others in action; the decorative lighting on the streets, buildings and roofs; the swelling throng of theatergoers, are of themselves sufficient to interest and amuse, and the visitor to the city cannot but be strangely impressed with the wonderful showing.

STREET LIGHTING.

The selection of the form of illumination best suited to local requirements and which will best facilitate travel on the streets and make transportation on the roadway as safe at night as during the day cannot be made without careful study and consideration. New York possesses a number of thoroughfares whose illumination compares favorably with the best practice abroad and forms a standard for much of the future work in this country. Moreover, the lamp-posts themselves are works of art which fit in with their respective surroundings and reflect the culture of the city. The various details of ornamentation and the general make-up of the posts are worthy of study, representing as they do the result of years of painstaking labor on the part of the associate general manager of the New York Edison Company. A description of the standard posts will be found in the *Electrical World*, Dec. 8, 1910.

The illumination of Fifth Avenue with its twin arcs makes this well-known thoroughfare very attractive at night and the lighting of Seventh Avenue north of Central Park to its terminus at Central Bridge, a distance of over 2 miles, is beyond question one of the best examples of street illumination in the country. About 26 kw per mile is used. The street is about 150 ft. wide and has a narrow strip of parkway in the

Fig. 1—The "Great White Way," Looking North from Times Square.

center, making it desirable to arrange the lamps in three rows. A rather complete account of this installation, with illumination curves and data, was published in the *Electrical World*, Nov. 7, 1908. The lighting of both of these thoroughfares is

Fig. 2—Fifth Avenue, Looking South from Forty-second Street.

beyond general American practice and, in fact, beyond average New York practice, too. It may be interesting to note that the lighting of the public highways in New York is under the jurisdiction of the Department of Water Supply, Gas and Electricity, which so far has manifested commendable progressiveness in the instances cited. The large public squares are at present being lighted by flaming-arc lamps mounted on high posts. This work is more or less experimental and the practice has not as yet become standard. Otherwise inclosed-arc lamps are employed, although flaming arcs are also employed to a limited extent on the various bridge approaches. The four magnificent bridges which span the East River are lighted by inclosed arc lamps which make a splendid spectacle.

PARK LIGHTING.

The tungsten lamp is very largely employed for park and boulevard lighting in New York, replacing gas and naphtha lamps formerly employed for this purpose. Central Park and Riverside Drive in Manhattan and Prospect Park and Fort Greene Park in Brooklyn, together with a number of smaller parks, are now lighted almost exclusively by this means. The illumination of such places, comprising winding roadways and footpaths lined with trees, necessarily calls for small units mounted low enough to be clear of the overhanging foliage. The results obtained from the use of tungsten lamps for this purpose have been very satisfactory. The lanterns used were chosen by the Municipal Art Commission. That most widely employed consists of three hinged interlocking sections which provide socket and globe-holding devices and means for quickly cleaning and replacing the lamps, reflectors and globes. Many other types of approved standards are also employed. All are made of cast iron and are given a verdi-bronze finish. The tungsten lamps used are rated at 60 watts. The type of glassware varies with the location of the lamps. Along the Mall, for instance, in Central Park and about the public buildings round white globes are employed to diffuse the direct glare of the light and to add to the artistic treatment, while along the paths and roads a clear-glass globe is used. The lamps are fed from underground armored cable placed directly in trenches dug in the soil and afterward covered over again and sodded. The circuits are controlled in sections. Arc lamps, however, are still used around the large lake in Prospect Park, Brooklyn. These are hung from arms extending out over the lake so as to offset the effect of the trees and are especially useful in lighting the lake during the winter when it is frozen over and given up to skaters. The New York Edison and the United Electric Light & Power Companies both supply energy in Manhattan for this purpose, as does the Edison Electric Illuminating Company of Brooklyn in the "City of Churches."

WINDOW LIGHTING.

Electric store-window lighting is everywhere seen in the business districts of New York. Two main classes of illumination are used, one in which the object is to display the goods and the other in which the object is to attract the attention of those passing at a distance from the window. Oftentimes flaming-arc lamps are used on the exterior and tungsten lamps in reflectors or bare in the window. Even during the day awnings are lowered and artificial illumination from tungsten lamps is employed to display the goods in the windows. This practice is becoming quite general. The New York Edison Company uses electricity very liberally in the show windows of its branch offices and maintains probably the most brilliantly lighted show windows in New York. In its West Forty-second Street office the ceiling above the two windows and the entrance is studded

Fig. 3—The Plaza at Night.

with eighty 100-watt tungsten lamps each equipped with a prismatic reflector which concentrates the light directly beneath it. The total downward candle-power in each window is in excess of 25,000 and the illumination at the bottom of each window is 100 ft.-candles. When it is remembered that 10

ft.-candles is probably the maximum intensity ever required the figures given above will convey some idea of the intensity of illumination in these windows. The lighting is effective because the source is hidden from the eye of the passer-by.

Fig. 4—Seventh Avenue North of Central Park.

Excellent examples of window lighting designed to display goods are afforded by the many large department stores in the shopping district on Sixth Avenue, Fifth Avenue, Broadway and in the vicinity of Herald Square.

DECORATIVE AND SIGN LIGHTING.

There is much decorative and curb lighting in New York; much more, in fact, than one would imagine. The numerous signs, however, serve to divert attention from both. Most of the decorative lighting is found in the hotel district, where lighting standards are maintained on the curb line. Some of the hostelries have their roof copings traced in electric light, while others have standards along the ridges and maintain elaborately lighted roof gardens which may be seen from a distance. Not a few theaters also have roof gardens. New York, however, glories in its signs, which are so numerous that only the largest ones can receive attention. Every theater of any consequence is more than amply equipped with electric signs advertising the name of the attraction and that of the playhouse. During the season the theatrical district is simply one blaze of light, each theater seemingly striving to outdo the others, and inasmuch as a half dozen theaters oftentimes adjoin each other, the effect is dazzling. At the present time many of the theaters are closed for the season, so that the number of these signs is considerably reduced. The Hippodrome, at Sixth Avenue and Forty-third Street, uses more electricity than any other playhouse in the city.

The accompanying illustrations were made from photographs taken within the past week and show as well as engravings can the present appearance of New York's "White Way," signs, streets, parks, etc. Imperfect as the photographic and engraving arts are, the illustrations nevertheless give some conception of the splendor of the city at night.

The sign at the southwest corner of Seventh Avenue and Forty-second Street, shown in Fig. 9, has been one of the longest in service and is considered by many to be the most effective advertising sign in New York. It is 50 ft. high and 56 ft. wide and is designed with red, green, white and purple colors and 2030 lamps. The lady herself is 40 ft. high and her parasol is 15 ft. in diameter. Her shoe is 6.5 ft. long. The falling of the rain and the switching about of the lady's skirt are most realistic. The sign is particularly appropriate for the situation also, since Times Square is one of the windiest spots in the city. The rain effect is intermittent, being switched on and off every twenty seconds. The girl's skirt is in constant motion, apparently flapping in the gusts of wind. This effect is produced by a series of very rapid flashes of the bulbs forming the bottom of the skirt and petticoat.

One of the prettiest signs at present in operation is located at Broadway, Seventh Avenue and Forty-seventh Street at the head of Long Acre Square and is visible for some distance on Broadway and Seventh Avenue. White, red, green and gold lamps to the number of 3725 are required in the design. The total height of the sign is 62 ft. and the maximum width is 50 ft. The diameter of the clock dial is 27.5 ft., the height of the numbers, 4.5 ft; length of minute hand, 9.33 ft.; length of hour hand, 7 ft., and height of lion's heads, 10.5 ft. The display is the latest addition to the "Great White Way" and is a splendid illustration of a sign which, while it is as impressive an advertisement as can be evolved, yet is equally artistic and pleasing to the eye. The action is that of two great streams of water playing from the lions' mouths. The clock shows the correct time at all hours of the day and night, and in the engraving reveals the length of time the plate was exposed in making the photograph. It will, of course, be understood that flashing effects cannot be reproduced in a photograph, which, because of the length of time necessary to take the picture, shows all the effects combined. This is particularly apparent in the huge chariot-race sign described elsewhere in this article.

Fig. 5—Tungsten Lamps on the Mall, Central Park.

The location at the head of Long Acre Square is one of the best for advertising purposes in the city and usually contains some of the most effective signs. A sign located at that spot some time ago advertising a beverage contained 2807 incandescent lamps in white and red. The total height of the sign was 57 ft.; its total width, 50 ft. The bottle containing the beverage was 39 ft. long, whereas the trademark and the name of the beverage were shown in letters 13 ft. and 4 ft. high respectively. The mechanism of the sign caused it to make three distinct flashes, the first showing simply the bottle and lettering; the second showing the effect of the cork having popped and the contents of the bottle shooting into the air; the third showing the liberated liquid foaming down the neck of the bottle. The rays denoting the effervesence shot 43 ft. into the air.

One of the largest animated electric signs ever built is located on the roof of the Hotel Normandie, at Broadway and Thirty-eighth Street, and faces toward the south. The sign contains approximately 20,000 incandescent lamps ranging in size from 2 cp to 32 cp, and 100-watt tungsten lamps are employed in reflectors to bring out the sky effect. It is estimated that about 600 hp is required on the structure containing the sign. The latter rises 72 ft. in the air above the roof of the hotel and is 90 ft. wide. It carries a Roman chariot race of such design and proportions that from the street below the vivid scene of light, color and action is reduced to normal

Fig. 6—Riverside Drive North of 108th Street.

Fig. 8—West Forty-second Street from Times Square.

Fig. 7—The "Great White Way," Looking South from Times Square.

size. Fig. 11 shows the sign from a distance, the main chariot driver and horses are 20 ft. high and 40 ft. long and the wheels of the chariot are 8 ft. in diameter. The design of this moving picture is based upon the operation of the lamps in great part. These flash until the walls of the arena appear to be left behind. When the motor-operated switches are thrown in, fore-

Fig. 9—Sign at Seventh Avenue and Forty-second Street.

most in the race appears a huge pair of horses outlined in fire galloping madly and drawing the rolling chariot and giant rider on to victory. The arena track apparently moves from beneath the swiftly rolling wheels and plunging horses. Back of the main chariot is another chariot. The front of the stadium wall is decorated with festoons and colored bulbs gracefully draped in artistic clusters. The different figures and stagings are cut out of metal, the chariot traces, capes, breast collars and harness are painted in red and gold and studded with ruby and amber-colored lamps. The roadbed of the arena is painted to simulate tracks and dust and is illuminated

Fig. 10—Sign at Broadway and Thirty-eighth Street.

with over 1000 bulbs. With one device, the horse's limbs are thrown backward and forward so as to cause the horses to seem to be running at terrific speed. Another device causes the wheels of the chariot to appear to revolve so swiftly that the spokes cannot be seen; another device causes the crimson robe of the leading charioteer as well as his Roman skirt to flutter. Other details are carried out with more or less reality. At the top of the display in mid-air is a great steel curtain, 90 ft. long

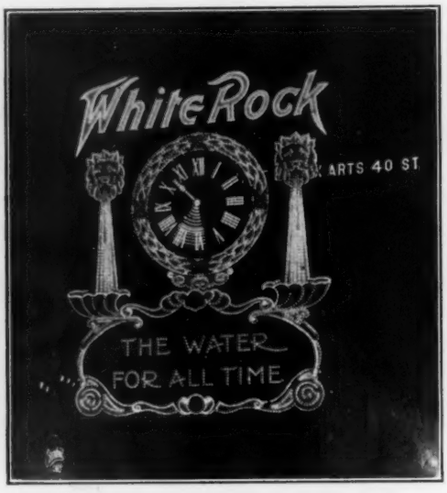


Fig. 11—Sign at Intersection of Broadway and Seventh Avenue.

and 20 ft. high, outlined with a border of lamps. The curtain is suspended directly over the main horses, so as to dominate the display. This space is used for advertising and covers nearly 1800 sq. ft. On this surface each advertisement is displayed in turn, there being room for fifty-four letters and spaces. Rows of eighteen letters each are made of monograms 4 ft. high, each capable of being read from a distance. The sign is lighted every night from dusk until midnight; about 750 switches are operated by means of two 10-hp motors and the flashes are designed to give 2500 impulses of light in a minute.

On the roof of a building at Seventh Avenue and Forty-seventh Street, overlooking Long Acre Square, a sign has recently been placed in operation advertising a certain brand of underwear. This sign is shown in Fig. 12. Its total height

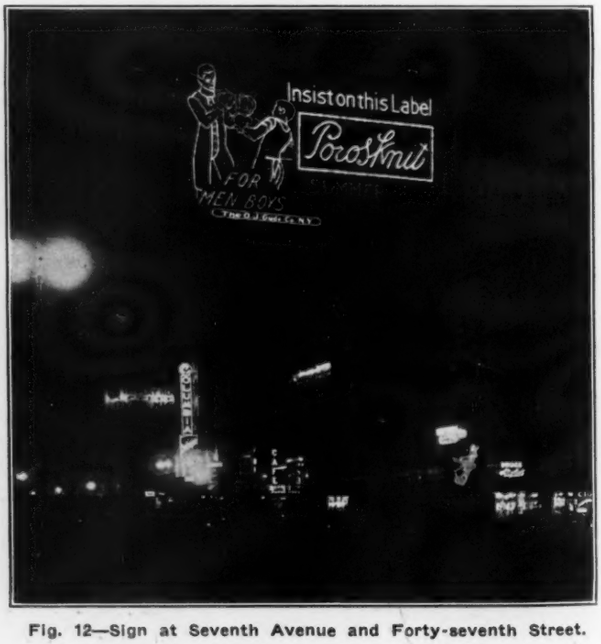


Fig. 12—Sign at Seventh Avenue and Forty-seventh Street.

is 60 ft. and the total width 108 ft. The height of the largest letter is 17½ ft., whereas the other letters are 6¼ ft. high. The width of the boxing glove is 8 ft. The panel is 24 ft. high by 59 ft. wide and all the lettering in the sign burns continuously.

A total of 3430 lamps is used in white, green and red colors. The action shows two men boxing and is continuous.

On the roof of the Hotel Albany, at Broadway and Forty-first Street, is a sign facing south, advertising a brand of chocolate. The framework is 50 ft. high and 45 ft. wide and the height of the boy is 30 ft. There are 2118 white, green, yellow and red lamps employed. The action of the sign is as follows:

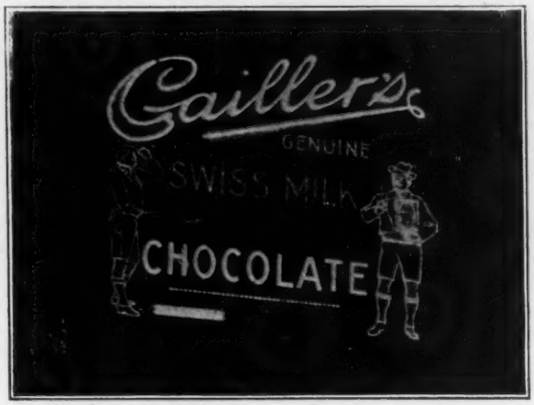


Fig. 13—Sign at Broadway and Fortieth Street.

The boy at the left end of the sign is flashed on and bows three times. The lamps are then extinguished and the boy at the right is switched on. This boy is shown holding a slate in his left hand, and while the forefinger of his right hand moves up and down with each downward movement a different letter appears on the slate until the word "chocolate" is spelled out. Simultaneously the large word chocolate in the body of the sign is also spelled out. The mechanism of the slate is made up of a monogram box and can be made to flash any letter in the alphabet. The name of the chocolate does not flash.

At Broadway and Forty-ninth Street, visible from Long Acre Square, there has been erected a sign within the past few weeks advertising a make of gloves. The total height of the sign is 56 ft. and it has a width also of 56 ft. The length of the lady's arm is 38 ft., while that of the glove is 34 ft. The letters are 9 ft. and 6 ft. high respectively and 1677 lamps in white, red and blue colors are required in the design, which is shown in Fig. 14. A series of flashes in this sign shows the woman holding a glove in her right hand at arm's length and putting it on her left hand.

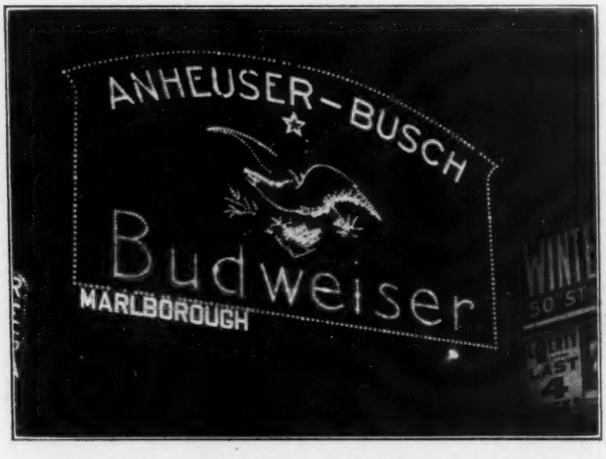


Fig. 14—Sign at Broadway and Thirty-seventh Street.

At the corner of Broadway and Sixth Avenue, overlooking Greeley Square, is an enormous sign advertising a chewing gum. The framework is 48 ft. high by 153 ft. wide, and the package is 52 ft. long and 20½ ft. wide. The length of the spear is 101 ft. and words are made up of letters 14 ft. and 12½ ft. high respectively. A total of 2950 red, white and green lamps burn steadily in this design. A similar sign advertising the same

Fig. 15—Broadway Above Fifty-fifth Street.

product can be seen on a roof between Eighth Avenue and Broadway at Fifty-second Street.

For some time there was located on the roof of the Hotel Albany and afterward at the corner of Broadway and Forty-second Street a rather taking sign advertising a celebrated silk thread. This sign was 50 ft. high by 46 ft. wide and contained 1900 red, white and green lamps. The action of the sign consisted of the unwinding of silk thread from the spool and a continuous motion of a kitten's paws. The kitten was 36 ft. wide by 30 ft. high, and the spool 15 ft. long and 10 ft. high. The lines of red globes representing silk were made to appear across the kitten until the thread seemed to be all tangled up. The kitten and spool were then switched off for an instant and the entire effect repeated.

On 125th Street a well-known cleansing commodity is advertised on a sign 63 ft. high by 106 ft. wide; the Dutch girl is 63 ft. high and the length of the baton which she wields is 29 ft. There are 3100 white lamps in this sign. The baton and the arm of the girl are in constant motion.

It is a singular fact that the signs along Broadway hitherto have generally appealed to one's thirst rather than to anything else. The forerunners of the present signs have in a great majority of cases called attention to champagne, wine, cognac, Scotch whiskey and the like. Not all of these commodities,

Fig. 16—Sign at Broadway and Forty-ninth Street.

however, have ceased to be advertised. For instance, overlooking the North River is a sign 51 ft. high by 103 ft. wide made up of 10-ft. letters advertising a local brand of lager beer. There are 2932 white, yellow and red lamps in the sign, whose

attractive feature consists of a bottle 40 ft. long and 11 ft. wide together with a glass 17 ft. high and 9½ ft. wide. The lettering of the sign burns constantly, while the lamps in the glass and bottle flash in such manner as to give the appearance of liquid flowing from the bottle into the glass, the glass filling up as the bottle apparently empties. When the glass is full the lamps in the bottle and glass are extinguished and then switched on again, whereupon the effect is repeated.

At the corner of Broadway and Forty-sixth Street overlooking Long Acre Square is a 50-ft. x 54-ft. sign advertising a brand of whiskey. The sign represents a man on horseback carrying a banner. The horse from ear to tail is 54 ft. long, his head is 16 ft. high and the length of the sabre carried by the horseman is 14 ft. The letters are 12 ft. high, and the whole design requires 1254 red, white, gold and green lamps. The sign burns steadily with the exception of the banner outline and the lettering contained in it, which are in continuous motion, as it were, giving the effect of a banner being fanned by the wind.

At the corner of Broadway and Thirty-seventh Street is a sign advertising a well-known beverage brewed in St. Louis. The design is 50 ft. high by 72 ft. wide, and the width of the eagle in the trade-mark is 41 ft. The largest letter is 14½ ft. high and there are 2214 white, red and green incandescent lamps in the entire design. The advertisement is brought up on four flashes. At first the name of the manufacturer appears, then the eagle and trade-mark, then the well-known name of the beverage. The sign is then switched off entirely and comes up again all at once, when the original cycle is repeated.

The signs above described are supplied for the most part from the mains of the United Electric Light & Power Company and the New York Edison Company, although a few receive energy from isolated plants located in the buildings on which these signs are erected.

Fig. 17—View of Fifth Avenue at Night Looking North from Forty-third Street.

Fig. 18—New York by Night from Center of Manhattan Bridge.

THE BROOKLYN EDISON SYSTEM

GENERATING STATIONS, SUBSTATIONS AND CHARACTER OF LOAD IN CITY OF CHURCHES.

BROOKLYN has a population of 1,635,351 and covers an area of 77.5 sq. miles. It is served with electricity by two companies, the Edison Electric Illuminating Company of Brooklyn and the Flatbush Gas Company, the latter company, however, having a limited output. The mains of the Edison company serve approximately 56 sq. miles, supplying electrical energy to over 26,000 customers. The income per customer is larger than that of any other of the large companies in the country. This is not because of high rates, as the average rate is not high and for customers having a good load-factor is quite low. The large income per customer indicates rather that the field has been fairly well plowed and that each customer has received individual attention. When the company started operations in 1889 the connected load naturally was quite small. On Jan. 1, 1890, there were connected to the Brooklyn Edison system 6600 16-cp equivalents. After twenty-two years of development, or on the first of the present year, the connected load was over 2,000,000 50-watt equivalents, and half of this load was acquired during the past five years.

THE SYSTEM IN GENERAL.

The company operates two generating stations, one at Sixty-sixth Street and New York Bay and the other at Gold Street and the East River. Both stations generate 6600-volt, three-phase, 25-cycle energy, which is transmitted at that potential to substations scattered about the city according to the location of the various centers of distribution. In these substations are installed step-down transformers, rotary converters, direct-current balancers, boosters, storage batteries, motor generators, arc generators, mercury rectifiers, regulators, switchboards, etc., for controlling the machines, batteries and the incoming and outgoing feeders.

Underground direct-current distribution obtains for the business, factory and adjacent residential districts of the city and for the congested district at Coney Island, while 60-cycle, two-phase distribution is accorded the outlying residential and suburban districts, most of the wires being overhead. That section of the borough bounded by Broadway, Fulton Street and the East River, and including a section over a mile wide north of Broadway and south of Fulton Street, together with the district between Prospect Park and the river, is served with three-wire Edison service at 120-240 volts. Customers outside this district are supplied with 60-cycle energy fed from substations at 2500 volts, two-phase, and stepped down to 120 volts and 240 volts at or near the customer's premises.

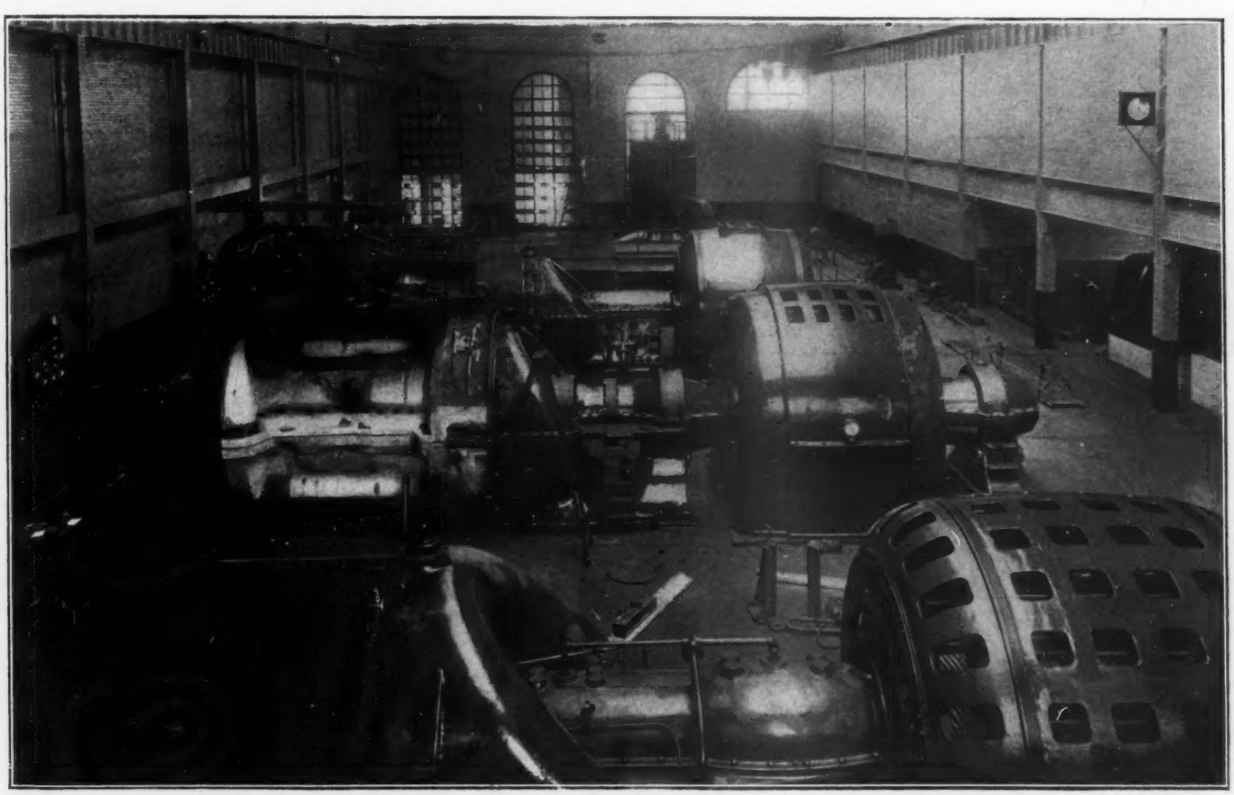


Fig. 1—Main Generating Station, Brooklyn Edison Company, at Gold Street and East River.

The direct-current service is supplied from rotary converters which deliver energy to the substation buses at from 220 volts to 250 volts. The alternating current, which is received as three-phase, 25-cycle energy, is passed through frequency changers, where it is transformed into 60-cycle, two-phase energy and distributed to the line transformers at a tension of 2500 volts.

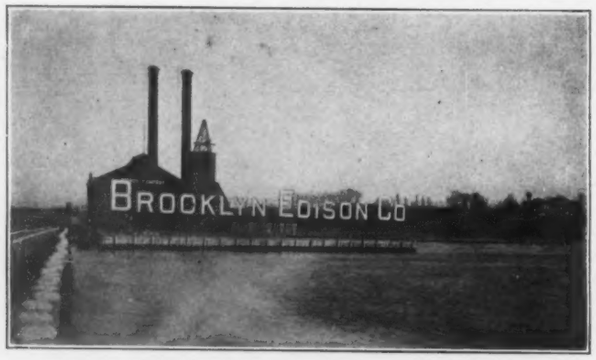


Fig. 2—Bay Ridge Station from New York Bay.

GENERATING STATION.

The Sixty-sixth Street station, which was erected in 1897, has the distinction of being the first station in this country built to generate alternating current at high potential for transmission to distant substations, there to be stepped down and converted for local distribution. At this station there are five engine-driven units, one Hamilton cross-compound, horizontal engine direct-connected to a 750-kw generator; one McIntosh & Seymour twin-compound, horizontal engine direct-connected to a 1500-kw generator, and three vertical Westinghouse cross-compound engines, each driving a 2850-kw unit. All the generators have been re-rated by the company according to their continuous maximum carrying capacity, the units having outputs of 1000 kw, 2000 kw and 3250 kw respectively. The three large engines are equipped with Worthington barometric condensers, while the smaller engines exhaust into a common ejector-type condenser, the circulating water being drawn from and discharged into the bay.

Steam for these units is furnished by twelve Aultman & Taylor boilers rated at 500 hp, six Babcock & Wilcox boilers rated at 550 hp, and six Aultman & Taylor boilers rated at 550 hp, none of which is equipped with superheaters. All the furnaces are fitted with shaking grates on which No. 3 buckwheat coal is burned under forced draft. Coal is brought to the station in barges and elevated by a Mead-Morrison coal-handling system into outside and inside bunkers or stored in an outside bin capable of holding 15,000 tons. A McCaslin conveyor is also installed for transferring the coal from the outside bunker to the inside bunker. The coal is delivered to the operating floor through chutes.

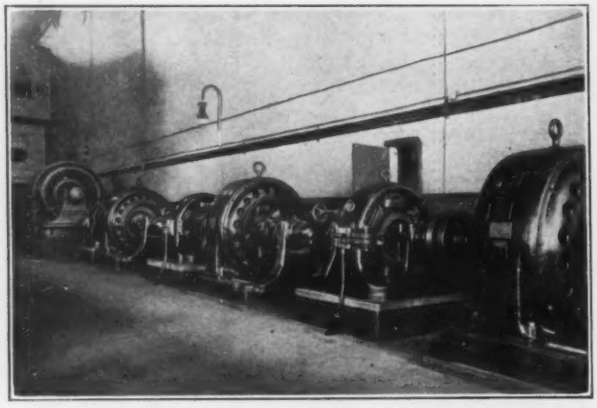


Fig. 3—Exciters and Motor-Generators, Sixty-sixth Street Station.

The switch and bus compartments for handling and controlling the high-tension energy are situated at the end of the operating-room, but separated from it by brick walls. Each generator cable on its way to the busbars passes through two motor-operated, oil-break switches in series, mounted in brick compartments, and the feeder cables pass through similar switches from the busbars to the subways. There are two sets of busbars, each set being divided in two parts by a bus tie switch. The switches are so arranged that any generator and any feeder may be connected to either bus, all of the switches being controlled from an operating gallery situated just inside the wall dividing the bus house from the operating-room, and which affords a view of the entire engine-room. On the operating boards, besides the control switches for operating the oil switches, are mounted also all the instruments required for the synchronizing and control of the generators and feeders, the operator being able to note at all times the condition of the system. All feeder switches are supplied with time limit relays which automatically open the oil switch of the feeder in case of short-circuit. Generator switches are also equipped with relays, but the contacts are connected to light a lamp on the switchboard instead of opening the oil switch. A feature of note in this station is the wiring on the rear of the switchboard, the neat arrangement of which is shown in Fig. 7.

MAIN STATION.

The Gold Street station as it now stands bears no resemblance to its former appearance, having been almost completely rebuilt since 1905. The original installation consisted of six Stirling boilers of 500-hp rating equipped with under-feed stokers, and four 1000-hp Reynolds-Corliss engines driving 750-kw alternators. The growth of the system and the demand for greater output resulted in a complete change in the layout in order to economize space and at the same time greatly increase the output of the station. The present equipment in the Gold Street station comprises one 7500-kw and one 8000-kw Allis-Chalmers horizontal turbine, one 10,000-kw Westinghouse unit and one 9000-kw Curtis outfit. The ratings given are those designated by the Edison company and are based on the continuous maximum load each unit is capable of carrying.

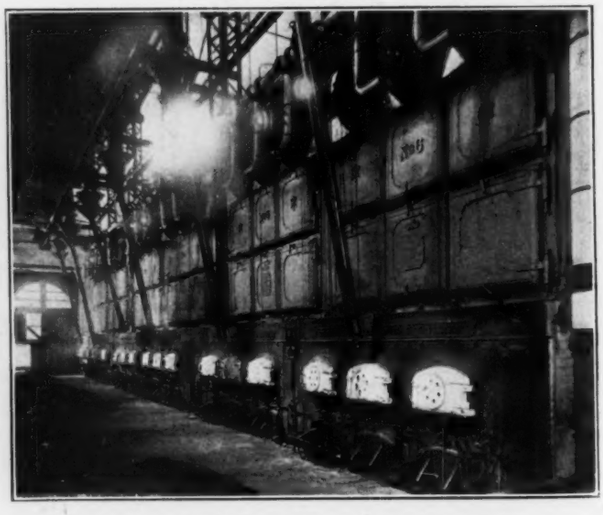


Fig. 4—Boiler-Room, Sixty-sixth Street Station.

BOILERS.

The boiler equipment consists of six 750-hp Babcock & Wilcox boilers and ten 750-hp Aultman & Taylor boilers, fourteen of which are equipped with superheaters. The boilers are equipped with Webster furnaces or arches over the furnaces. Thirteen of the furnaces are fitted with shaking grates divided

into eight sections, enabling the fireman to shake any portion of the fire desired. Three of the furnaces are fitted with dumping grates, and all are hand-fired with a mixture of 85 per cent of No. 3 buckwheat and 15 per cent of bituminous. Back of the boiler-room is a new boiler house which, when complete, will house thirty-two 650-hp boilers. At present this house contains eight Babcock & Wilcox boilers fitted with superheaters and Taylor stokers and eight more boilers, to be similarly equipped, have been ordered. Ordinarily each boiler feeds 1000 kw of load, but at times of peak each can carry 1500 kw.

COAL AND ASH HANDLING.

The coal is brought to the dock in barges and hoisted above the top of the coal bunker by a Mead-Morrison coal tower in an automatic clam-shell bucket. The hoist is operated by a bucketman, who raises and lowers the bucket, dropping it open into the barge to dig the coal and opening it when over the receiving hopper, and a trolley man, who guides the bucket in and out on the boom and over the receiving hopper at the top, for the bucketman to dump the coal. With this hoist 150 tons of coal an hour is the average amount handled. The station is equipped with two of these hoists.

The coal is delivered from the receiving hopper through a coal crusher to break the bituminous coal so that it may be properly mixed with the anthracite. From here it is dropped by gravity to self-dumping cable cars, located on a weighing scale. Each car holds 3 tons, and when the scale balances the car is hooked to the cable, which conveys it to any desired point over the coal bunkers, where it is automatically dumped by a tripping device operated by the car man. The coal is drawn through self-closing gates from the bottom of the coal bunker into a 4-ton electrically operated distribution hopper, which travels the entire length of the boiler-room and is handled by coal passers, one on each eight-hour watch, who keep a supply of the proper mixture of coal in front of each boiler that is being fired.

The ashes and clinkers are dropped through the grates into ash hoppers in the basement. On the bottom of each ash hopper is a gate by means of which the contents of the hopper is emptied into dump cars, which are pushed over to the bucket conveyor at the river end of the boiler house. The ashes are then dumped into a receiving hopper and elevated by the conveyor to a large ash hopper equipped with chutes for rapid unloading into barges. The ash equipment is capable of loading a 600-cu. yd. ash scow in twenty minutes. Each ash hopper has a spraying attachment to wet the ashes from time to time. In order to prevent the wet ashes from freezing in winter the large ash bunker is fitted with steam coils.

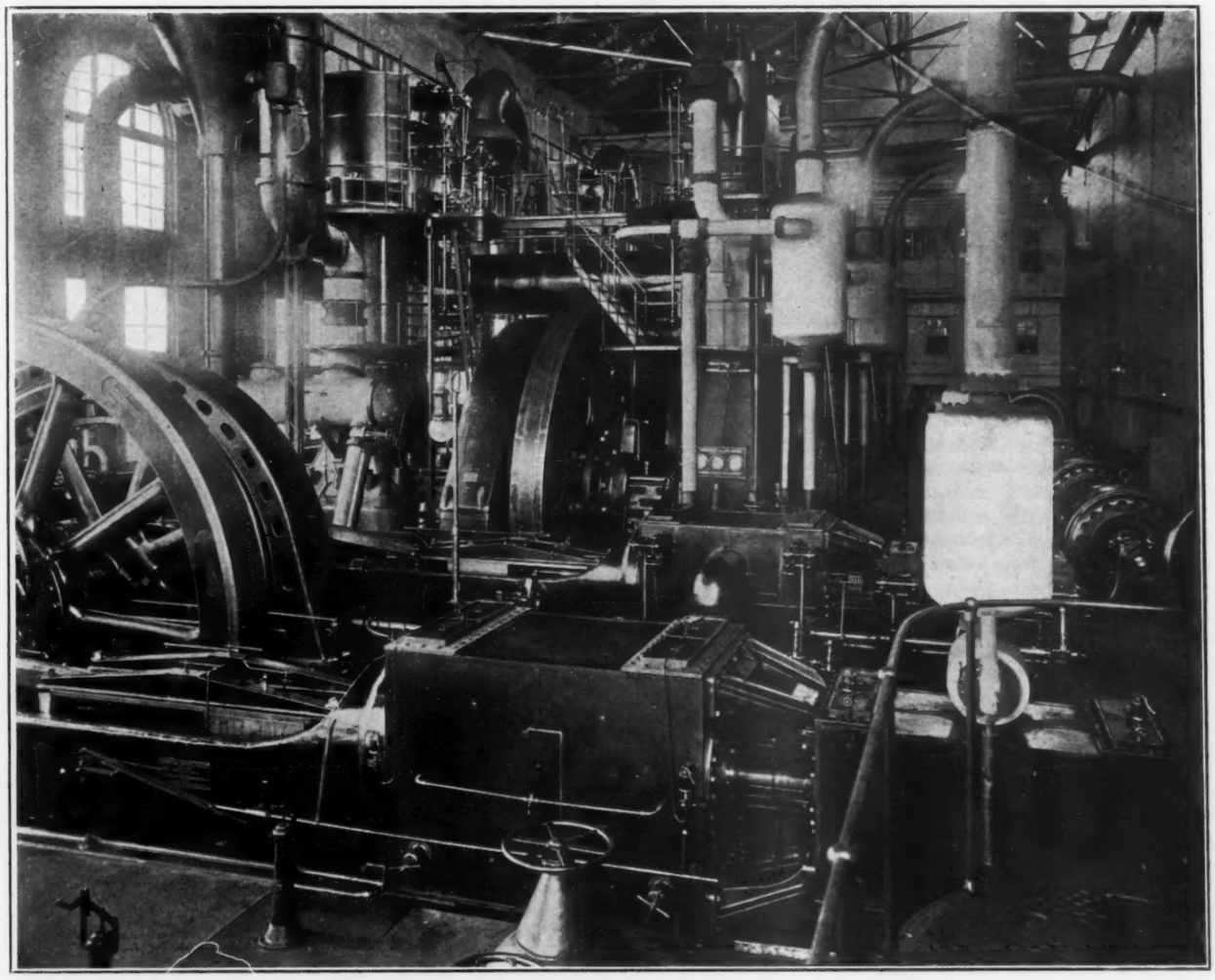


Fig. 5—Generating Station at Sixty-sixth Street, Bay Ridge, and New York Bay.

FEED WATER.

The feed-water mains are two lines of 6-in. pipe, one to each row of boilers. The pipes are interconnected to provide for feeding any boiler from either line, connections from these headers being of 3-in. pipe. The hot-well returns are collected in an 8-in. header leading to the heater, or in a 6-in. overflow line to the discharge tunnel. Two 6-in. connections to the city water mains furnish the make-up water. There are three Terry turbine-driven centrifugal four-stage feed pumps for regular surface and one reciprocating pump for emergencies and for boiler cleaning. The centrifugal pumps deliver 1000 gal. per minute against a pressure of 250 lb. per square inch. A 15,000-hp open heater is on the suction side of the feed pumps

and takes steam from the auxiliary exhaust header with a connection through 8-in. pipe to the atmosphere. There was originally installed in the Gold Street station a closed heater system, and with this apparatus the engineers were unable to main-

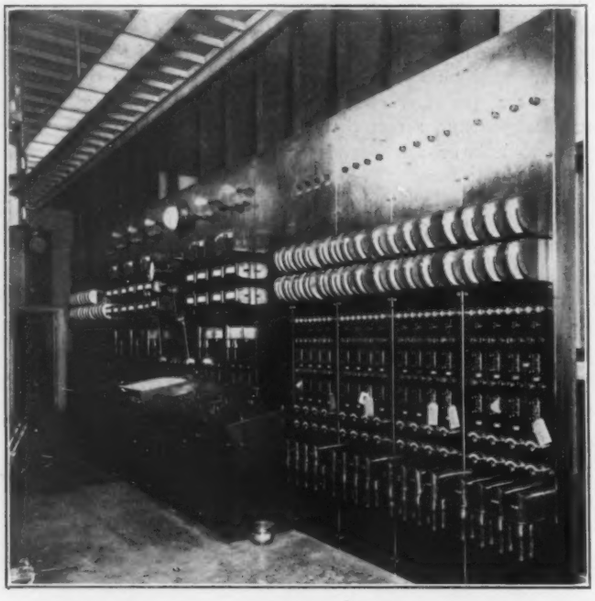


Fig. 6—Control Board in Sixty-sixth Street Station.

tain a temperature of more than about 180 deg., with a loss of approximately 12 per cent of the total returned auxiliary steam. Moreover, all of the condensation from the auxiliary steam apparatus was lost. With the open-type heater this steam, which now amounts to about 12 per cent of the total, is condensed, thereby making possible an additional saving and resulting in an increase in feed-water temperature of 33 deg., which amounts to about 3 per cent of the total coal consumption, or an increase of 1.7 per cent in the total economy of the station.

FORCED DRAFT.

The boiler breeching connects with one 210-ft. brick stack, 13½ ft. inside diameter and 210 ft. above the grates, and to one Custodus concrete stack of the same dimensions. When the new boiler house is completed it will be equipped with four steel stacks 15 ft. 4 in. inside diameter and 225 ft. above the floor.

The forced-draft system for the boilers consists of an air duct on each side of the old boiler house, extending its entire length, to which eight boilers are connected by air nozzles and dampers. The latter control the air to the individual boilers. Each duct is equipped with three blowers, located one at each end and one in the center. The blower equipment comprises one pair of 40,000-cu. ft. fans direct-connected to a 225-hp Bliss turbine and four pairs of 30,000-cu. ft. Sturtevant fans, two of which are direct-connected to Kerr turbines, one of which is direct-connected to a Terry turbine and the other of which will be connected to a Curtis turbine. In the new boiler house the forced-draft system is made up of a concrete air duct the full width of the firing aisle and running the entire length of the boiler house. Each of the sixteen boilers will be supplied with nozzles and dampers. To this duct there is at present connected two fan units, one a Bliss steam turbine with two Massachusetts fans, which is a duplicate of the units in the old boiler-house basement, and the other a Robinson fan rated at 80,000 cu. ft. per minute, which is driven by a Terry turbine. There is also on order an 80,000-cu. ft. Kerr fan, which will be turbine-driven.

CONDENSERS.

All of the turbines are equipped with surface condensers, the circulating water being drawn through a concrete intake tunnel from the East River and discharged overboard through a second tunnel. A complete description of the condensing equipment appeared in the *Electrical World* June 15, 1907.

The Curtis unit is equipped with a Wheeler condensing outfit, the condenser for which was designed for 20,000 sq. ft. of tube surface, 4000 sq. ft. of which was removed. There are two 18-in. Wheeler circulating pumps driven by a 240-hp turbine run at 750 r.p.m. The dry-vacuum outfit on this unit will be changed to standard Wheeler equipment, to be driven by a Cooper Corliss engine from the floor above. The wet-vacuum pump consists of a 5-in., two-stage Janesville outfit direct-connected to a 30-hp Kerr turbine run at 750 r.p.m.

The larger Allis-Chalmers set is equipped with a Worthington condensing outfit designed for 25,000 sq. ft. of tube surface and remodeled for 16,000 sq. ft. of surface. The circulating pump consists of a 24-in. Worthington side-suction volute pump driven by Harrisburg engines, whose speed may be regulated from 175 r.p.m. in winter to 225 r.p.m. in summer, so as to take advantage of the difference of temperature of the circulating water. The dry-vacuum pump is a standard Blake outfit, and the hot-well pump is a two-stage, 5-in. Janesville outfit driven by a Kerr turbine.

The condensing outfit for the Westinghouse unit is of the Alberger type fitted for 25,000 sq. ft. of surface and operated with 16,500 sq. ft. The circulating pumps comprise twin suction volute pumps, driven by a 300-hp Westinghouse direct-connected motor. A 6-in., two-stage Alberger pump direct-connected to a 35-hp Terry turbine takes care of the hot well, and twin Alberger pumps driven by a Corliss engine comprise the dry-vacuum outfit.

The smaller Allis-Chalmers unit is equipped with Worthington condensing apparatus designed for and equipped with 20,000 sq. ft. of tubing. The circulating outfit is identical with unit No. 1. The hot-well pump comprises a two-stage, 6-in. Worthington outfit driven by a 35-hp Kerr turbine. The Curtis unit was the last to be installed, and it is possible by disconnecting a coupling to use either one or two of the circulating pumps, according to the temperature of the circulating water.

The company has experienced more or less trouble with con-

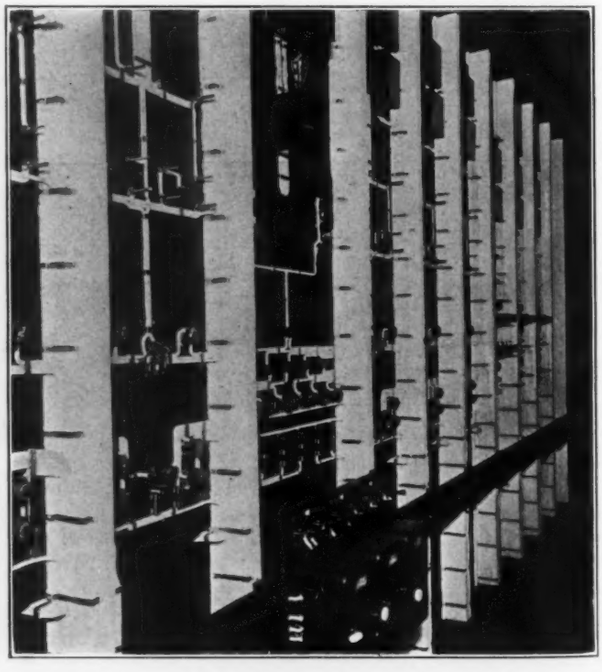


Fig. 7—Rear of Control Board, Bay Ridge Station.

denser tubes, and in only one case have the tubes stood up for any reasonable period. In the first unit installed the tubes remained tight and gave satisfactory service for a year, and in that time only twelve tubes have been replaced. All of these

twelve tubes have been taken out for exactly the same reason that all of the tubes of the other condensers have had to be taken out after from three to six months' service. The fault has been attributed to the spelter and copper not being properly incorporated, resulting in electrochemical action. The tubes are now bought on a guarantee, the manufacturer agreeing to replace every tube that splits or leaks within a year and also pay the cost of effecting the removal and replacement.

STATION OPERATION.

The boilers when not in use have their fires banked. The fire is first cleaned and spread over the grate and then covered with a thick layer of coal. The dampers are closed, cutting off all draft. During this process the steam pressure in the boiler drops below the pressure of the mains, which causes the automatic stop valve on the boiler to shut, the valve remaining in this condition so long as the boiler fires are banked. When the boiler is again wanted for service the dampers are opened and the fire shaken. As soon as the pressure has been brought up to about 1 lb. in excess of the pressure of the mains the automatic stop valve opens and the boiler is cut in service.

If a boiler has been out of service for some time for repairs or internal cleaning the method of starting up is as follows: The boiler is first filled with water to the lower gage cock and the superheater flooded. The grates are then covered to a depth of 3 in. with bituminous coal and fire from another furnace is thrown in on top of this bed. The fire is then covered with a little bituminous coal and subjected to a small amount of draft. As the fire builds up and the water in the boiler begins to turn into steam, the tube caps at both front and rear are examined for leaks, and the joints around the stop valves, cross-over pipes and superheater connections are also examined. If all joints are found to be satisfactory the fire is gradually increased until the steam pressure in the boiler has reached about 40 lb. The flooding valve on the superheater is then closed and the water blown out. The drip on the boiler bend connecting the automatic stop valve with the header is opened and then the gate valve on the header end of the bend. This permits the steam pressure from the other boilers to come to the upper side of the automatic stop valve. The hand-operated stem on this valve is then opened and the pressure on the boiler carefully watched until it reaches 1 lb. or 2 lb. in excess of the line pressure. At this point the stop valve opens and the boiler is cut in service.

The water tender is responsible for the condition of the fires,

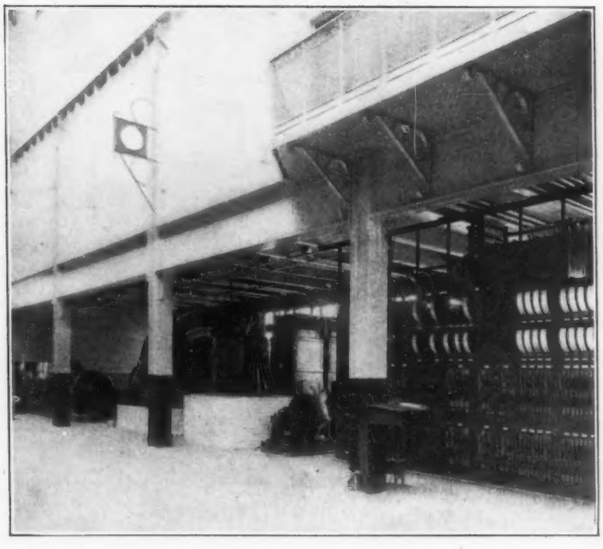


Fig. 8—Direct-Current Board in Gold Street Station.

the height of the water in the boilers and the steam pressure during his watch. He reports direct to the boiler-room engineer, who is responsible for the entire boiler house and all men connected with it during his eight hours of duty. A daily log sheet is kept showing the number of hours the boiler is under steam banked and shut down. An hourly record of steam pressure, steam temperature and feed-water temperature is also maintained. An hourly record is kept of the steam pressure,

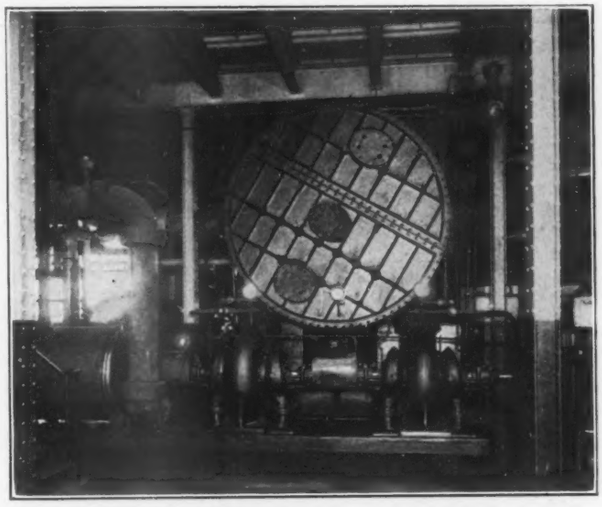


Fig. 9—Condensing Equipment of Curtis Unit.

inlet steam pressure, the vacuum and temperatures, and the number of hours each turbine is in service.

When placing one of the main units in operation an air siphon on the circulating pump and the condenser is started. This creates a vacuum in the circulating pump and water space of the condenser, allowing the water to flow from the intake tunnel through the circulating pump into the condenser. The circulating pump is then started, after which the auxiliary oil pump is started causing a circulation of oil through the main bearings and the governor of the turbine.

The throttle on the turbine is now opened a trifle so as to admit a small amount of steam to heat up the unit. After from thirty minutes to forty-five minutes the turbine is given steam enough to cause it to revolve at a rate of 75 r.p.m. for a period of five minutes. This is done so that the spindle and casing of the turbine may be heated up evenly and expanded alike around the entire circumference. The throttle is then shut and the turbine brought to rest. When the unit is required for service the operator in the switchboard gallery notifies the engineer by proper signals and the turbine is then brought up to speed rapidly. At the same time the pump oiler starts the dry-vacuum and hot-well pumps so that when the turbine is running at normal speed it has its full vacuum. Water is then turned on to the glands and oil cooler through which the oil from the bearings circulates. The switchboard operator then synchronizes the generator with the system, and as soon as this operation is finished and the switch closed the engineer is signaled to throw the throttle wide open. From then on the bearings must be examined every fifteen minutes and the temperature of the discharge oil noted. The pump oiler is also required to make an inspection of the bearings on the auxiliaries and of the height of the water in the hot well. The assistant watch engineer looks after the turbines and auxiliaries in order to make certain that the oilers attend to their duties. This leaves the watch engineer free to supervise the entire operation of the plant, and he is directly in charge of all of the steam-operating men. When the load is such that it requires two turbines, a third unit is kept hot and the auxiliaries running so that it may be put on the line in from one minute to three minutes. The practice heretofore had been that three turbines were kept running if the load was sufficient for two, and by merely keeping the third unit hot and the auxiliaries running a saving of 5.6 per cent is effected.

SWITCHBOARD.

The low-tension switchboard is on the main engine-room floor on the Gold Street side of the station under the mezzanines.

It has panels for the exciters, station motors, lighting and for the excitation equipment. The high-tension switchboard is of the remote-control type. The main control board is stationed on the first mezzanine, on the eastern side of the operating-room. From here are controlled the generator switches and feeder switches, and the feeder and generator-selector switches,

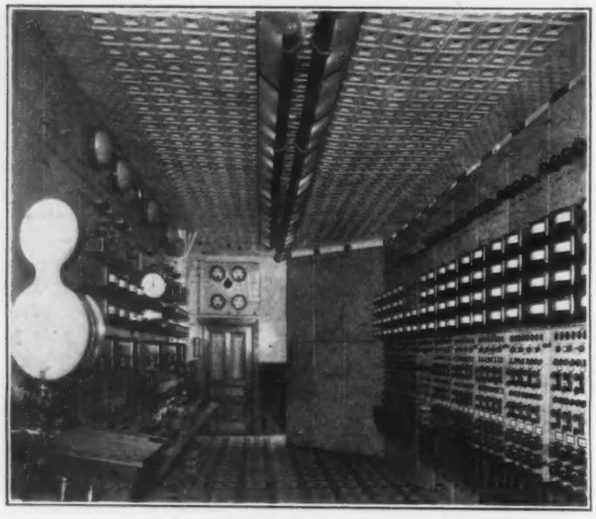


Fig. 10—Control Board, Gold Street Station.

which are of the motor-operated type. The generator and feeder switches are also stationed on the first mezzanine. The latter are rated at 300 amp and are automatic in operation. On the second mezzanine are located the feeder-selector switches, which are motor-operated and rated at 500 amp, the generator and generator selectors, rated at 1200 amp, and the main and auxiliary buses. Each bus is divided into three sections and is planned to accommodate eight generators, three generators at each of the two sections and two generators on the third section. The usual cross-connections are provided to enable either bus to be used.

Energy from the generators is transmitted in lead-covered, single-conductor, 10/32-in. varnished-cambric cables to the generator switch, which is of the non-automatic oil type. There is, however, a relay which lights a red lamp as a danger signal to the operator in case of trouble on the generator. From the generator switch the energy is transmitted in lead-covered, single-conductor, 10/32-in. varnished-cambric cable through automatic selector oil switches to either the main or the auxiliary bus. The three-phase, 6600-volt feeders are arranged in groups of two at the generating station and leave the bus through a disconnecting switch, through a selector oil switch (which is non-automatic and controls the group of two feeders), then through two separate automatic oil feeder switches. All feeder cables in the stations are three-conductor, 250,000-circ. mil section varnished cambric.

The two generating stations are normally operated in multiple and are only isolated in case of emergency. The practice of the company is to supply each substation with feeders from both generating stations, the feeders passing over different routes from station to station, so that in case of an accident to the feeders from one source the substation may be fed from the other. The transmission lines from both generating stations are entirely underground and consist of 250,000-circ. mil, three-conductor, lead-covered cables insulated to withstand two and one-half times normal pressure. The trunk subways are subdivided at the manholes, as far as practicable, so that trouble to one feeder cannot be communicated to others.

EXCITATION.

The excitation switchboard is on the turbine-room floor adjoining the substation board and is so arranged that it can be connected to the substation board in the Gold Street generating station. The excitation is supplied by a 250-kw, 125-volt generator driven by a 6600-volt, three-phase, 25-cycle induction motor. A 500-kw battery is kept floating on the excitation bus at all times. There are also a pair of 400-kw, 125-volt direct-current generators driven from a three-cylinder, compound Lake Erie engine. This engine is used as an emergency exciter and is arranged so that it may be put in multiple on the substation bus in emergency.

At the Sixty-sixth Street station the arrangement of the three-phase system and excitation is the same as that at the Gold Street station with the exception that there is no direct-current substation located in that generating station and the steam-driven exciters are only of 100-kw rating.

SYSTEM OPERATOR.

The three-phase, 6600-volt distribution system is controlled by system operators, who are under a chief system operator having charge of all electrical equipment in the generating stations and having direct supervision over all of the high-tension switchboards in the system. A miniature replica of the transmission system is kept by the system operator on watch, and shows the regular running condition of the circuits. The operator is kept advised by the chief engineer as to the capacity of boilers, turbines, engines, etc., that is available. All substation apparatus as it is put in or out of service is immediately reported and noted on the log at that time. This enables the system operator to be familiar always with the equipment which is in operation on the system. Nothing can be taken out or put into service without his permission. If the distribution or electrical construction department wishes a feeder or any piece of aparatus put out of commission it is required to give the operating engineer's office a written notice twelve hours in advance. Immediately upon receipt of this notice the chief system operator and the chief substation operator pass on it, and if in the meantime no emergency has arisen the feeder is taken out of commission in the following manner: The foreman who is

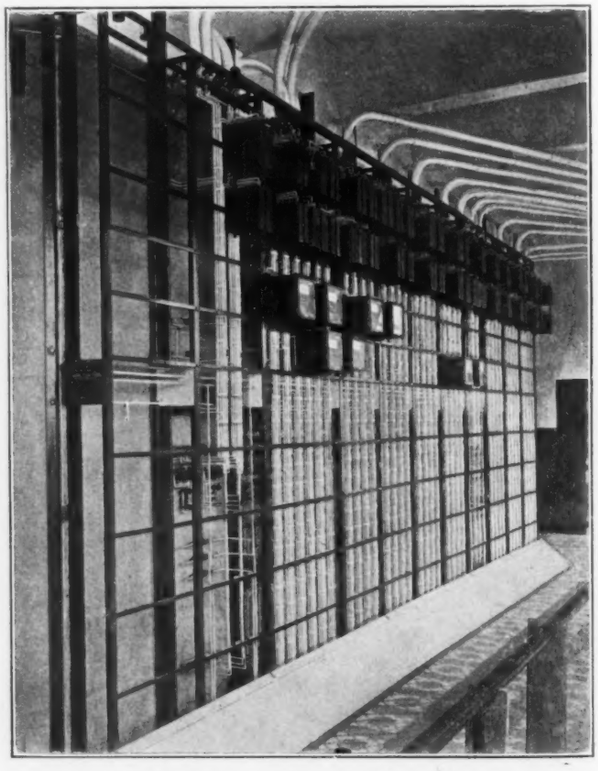


Fig. 11—Rear of Control Board, Gold Street Station.

in charge of the work calls the system operator on watch, giving his name and department. A red tag bearing his name is then placed on the control switch in the generating station and on the hand-operated switch in the substation. The oil switches are then mechanically blocked to prevent their being accidentally closed. The feeder is then short-circuited and dis-

charged to ground. No feeder or apparatus that has been taken out can be put back into commission again until the foreman or emergency man who ordered on the tag personally orders it removed. These precautions are taken to avoid accidents.

The system operator is provided with a private-telephone exchange with a main board by means of which all substations can be immediately reached over a direct wire. In this way the operator is enabled to call two, three or four substations at one time, giving them all the same orders. It has been found that by this method of communicating with the substations and by a proper method of answering the telephones half the time can be saved in telephoning. The method of answering the telephones is as follows: If a substation calls the system operator, his reply is "System operator." The substation operator then answers (for example): "Sumpter Street, Murray. No. 1 rotary going on, 5:15." This is repeated back by the system operator and the conversation is then completed.

EMERGENCY SERVICE.

Another of the system operator's duties is to keep a list of the men who are liable to be needed in case of a breakdown and to send out a call for as many of them as necessary in case of trouble on the system. A recent instance of this "emergency service" was demonstrated at the Erie Basin dry docks when one of the 400-kw, three-phase, 25-cycle, 440-volt motors on dock No. 4 burned out. The system operator was notified at 7:35 a. m. and at 2 p. m. the dock was equipped with two 200-hp motors, which had been installed in place of the 400-hp unit, and operations were again renewed.

A detailed list of all large motors, transformers, etc., which are in storage at any of the various storerooms is kept by the system operator, and he can immediately tell a customer or any of the company's employees if there is a piece of apparatus in stock which can replace any that has burned out or that has become defective in any way.

At the generating station there is always 2500 kw kept in reserve for the use of the high-pressure fire-pumping stations. In addition to all sudden demands at times required for the high-pressure pumping stations the company feeds two large shipyards which have floating dry docks and which may call for approximately 2000 kw at any time of the day or night.

In case of a general shut-down on the 6600-volt system the operators in the substations shut down, pull out the alternating-current switches of the machines and clear the 6600-volt board thirty seconds after the shut-down occurs. In the battery stations or where there is a supply of direct current from another source the rotaries are allowed to run from direct current.

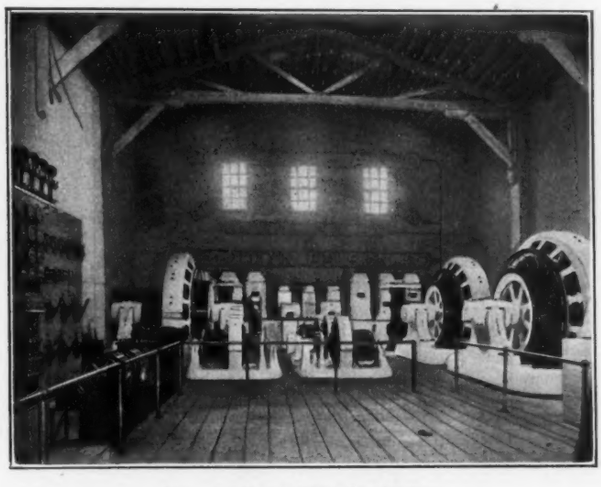


Fig. 12—Dreamland Substation.

When the pilot lamps indicate that service has been restored on three-phase feeders the operator switches on the station load at once in the usual way without further notice. After he has started the equipment the operator notifies the system operator and receives any further instructions required. In the event of any serious substation trouble or where difficulty is experienced in starting after the trouble, the system operator notifies the operating engineer and the chief substation operator regardless of the hour, day or night.

In the case of a partial shut-down, due to local causes or otherwise, the substation operator immediately starts up his equipment and feeds the normal load, unless otherwise notified by the system operator. In case of a shock on the system which does not automatically disconnect any of the feeders or apparatus the substation attendant does not call the system operator until twenty minutes after the trouble. In the event of a shut-down if the booster generators are between a battery and the bus—as, for instance, in charging the battery—or so connected that the load on the generators becomes very excessive, they are disconnected from the bus at once.

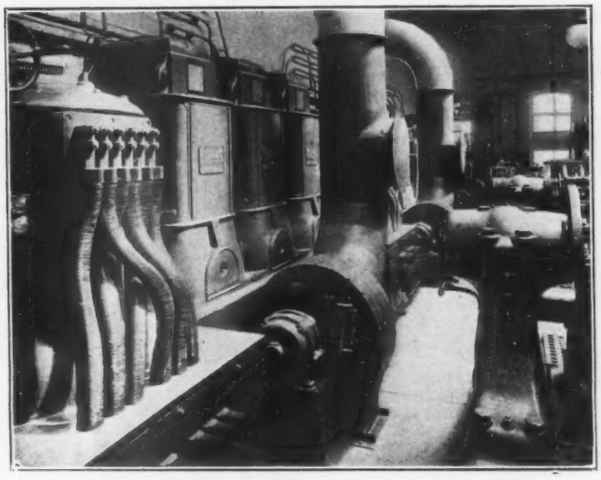


Fig. 13—Transformers and Regulators in West Twelfth Street Substation.

SUBSTATIONS.

The substations of the company are twenty-one in number and their locations and equipment are as given below:

The substation at Rockwell Place and De Kalb Avenue is equipped with four 1000-kw rotary converters, eight 100-light Brush arc machines, one 750-kw battery, one 50-kw booster, and one 90-kw and one 80-kw balancer.

The substation at 1265 Atlantic Avenue contains two 100-kw, one 400-kw, one 500-kw and one 1000-kw rotary converter, together with a 475-kw battery. This equipment will shortly be augmented by the installation of another 1000-kw rotary converter. The other equipment comprises a 50-kw booster and two 90-kw balancers.

A substation at 1171 Myrtle Avenue contains two 200-kw, one 500-kw and two 1000-kw rotary converters, and a battery rated at 500 kw. To this equipment will be added during the summer another 1000-kw rotary. This station also contains two 50-kw boosters and one 90-kw balancer set.

The large substation at West Twelfth Street and Railroad Avenue, Coney Island, from which Luna Park and a large part of Coney Island are supplied with electricity, contains one 100-kw, two 200-kw, two 500-kw and three 1000-kw rotary converters; one 500-kw motor-generator set, one 1000-kw frequency changer, and eight 100-light Brush arc machines, and another 1000-kw frequency changer has been ordered.

The Carroll Street substation is equipped with two 200-kw, one 500-kw and two 1000-kw rotary converters, one 500-kw battery, one 50-kw booster, and two 90-kw balancer sets. The Forty-second Street substation, from which the Bush Terminal Company is supplied, is equipped with two 100-kw, one 400-kw and two 150-kw rotary converter sets. The latter are 550-volt machines, whereas all of the other rotary converter sets are 240-volt machines.

The substation at the corner of Dikeman and Ferris Streets, which supplies energy to the Lidgerwood Manufacturing Company, is equipped with two 400-kw rotary converters.

The Gold Street substation, which, as already stated, occupies

space on the engine-room floor of the main generating station of the company, contains one 1000-kw rotary, two 400-kw engine-driven generators, which may also be used for excitation, one 500-kw battery, one 50-kw and one 75-kw booster, and one 90-kw balancer set.

The Lexington Avenue substation is equipped with two 200-kw, one 400-kw and one 1000-kw rotary converter, one 400-kw and one 200-kw frequency changer set, one 50-kw booster, and a 90-kw balancer. A 1000-kw rotary converter will be added to this equipment shortly.

The Ainslie Street substation is equipped with two 1000-kw rotaries, with a third unit of the same rating ordered; three 500-kw and one 1000-kw frequency changer, with another 1000-kw frequency changer on order; one 500-kw battery, twelve 100-light arc machines, one 100-kw and one 90-kw

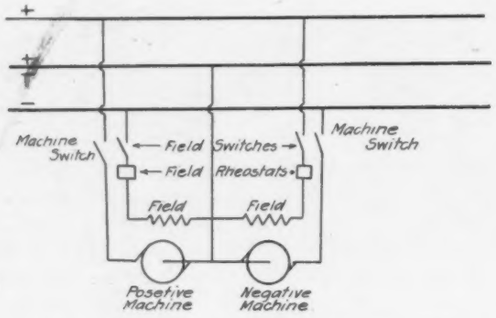


Fig. 14—Diagram of Balancer Connections.

balancer, and two 50-kw boosters. A 75-kw booster will also be installed within a few months.

The substation on Hall Street, which supplies a large industrial establishment, is equipped with two 500-kw rotary converters and two 90-kw balancers.

The Lorimer Street substation contains two 200-kw, one 400-kw and two 1000-kw rotary converters, a 750-kw battery,

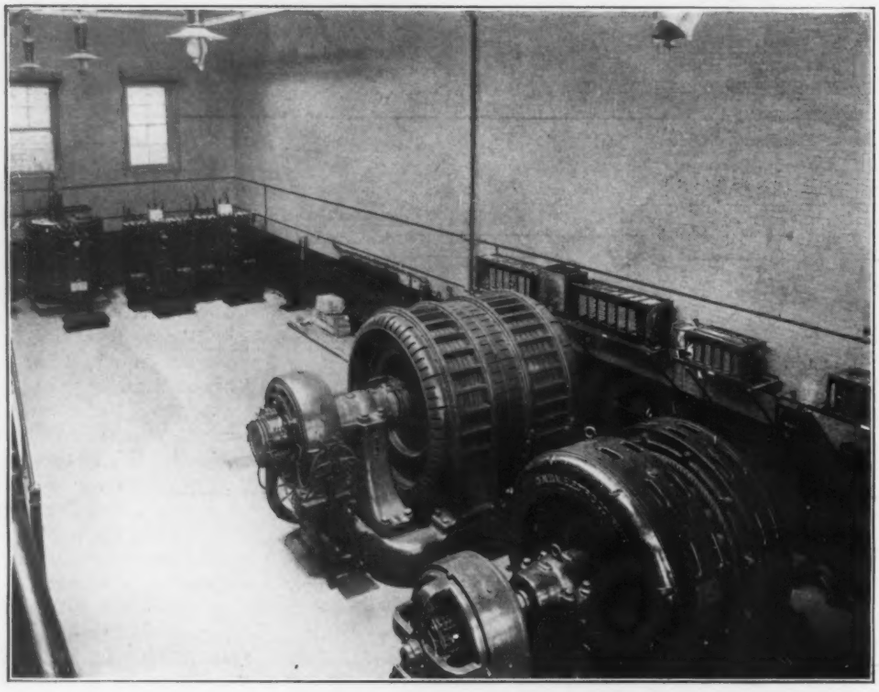


Fig. 15—Hicks Street Substation.

one 50-kw booster, and two balancer sets rated at 50 kw and 90 kw respectively. The company has recently ordered a 1000-kw rotary converter set, which will supplement the substation equipment in this station.

The Pearl Street substation, located in the main office of the company, contains two 200-kw, two 500-kw and four 1000-kw rotary converters, one 1500-kw battery, one 75-kw and two 50-kw booster sets, and a 90-kw balancer.

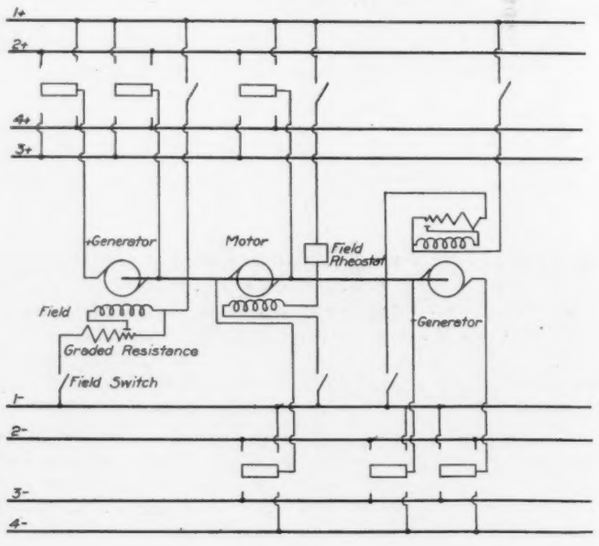


Fig. 16—Diagram of Booster Connections.

The Sumpter Street substation has the following equipment: One 500-kw and two 1000-kw rotary converters, one 500-kw and two 1000-kw frequency changers, eight 80-light mercury arc rectifiers, one 80-kw and one 90-kw balancer, and a 50-kw booster set. A 1000-kw frequency changer has been ordered for this substation.

The Madison Street substation contains a 1000-kw rotary and a 90-kw balancer set. In addition to this equipment there will shortly be installed another 1000-kw rotary converter and a 500-kw battery.

The Dreamland substation, from which the amusement resort of that name at Coney Island receives its energy, is equipped with two 100-kw and three 1000-kw rotary converters. This substation is operated only four or five months in the year, during the Coney Island season.

In the Sixty-sixth Street station the substation equipment comprises one 1000-kw and one 400-kw frequency changer set, with another 1000-kw frequency changer on order. There are also four mercury-arc rectifiers being installed.

The Hicks Street substation contains four mercury-arc rectifiers and one 400-kw and one 1000-kw motor generator set.

The substation in the Brooklyn Navy Yard is equipped with two 200-kw motor-generator sets.

Another Coney Island substation, located at Brighton Beach, is equipped with one 400-kw and four 100-kw rotary converters and a 500-kw frequency changer. In addition there are two 100-kw rotaries used as balancers.

The substation at Canarsie is equipped with one 150-kw motor-generator set and a 300-kw frequency changer.

GENERAL SUBSTATION EQUIPMENT.

The 6600-volt, three-phase feeders are brought into substations, which are equipped with two types of board. The older is of open-construction varnished-cambric cables supported upon insulators; the newer type is of concrete-compartment design. Only two of the substations are equipped with two-bus, high-tension boards. The older boards are all of single-bus construction, with the exception of those in Rockwell Place and Carroll Street. The newer type boards are divided in sections, which gives nearly the same flexibility as the two-bus construction and avoids a great many of the two-bus troubles.

All of the substations are equipped with "K" switches and hand control with the exception of those on Pearl and Ainslie Street, which are of the remote-control type operated by solenoids, although they are also arranged to be operated manually. Two feet above the end-bells at which each cable comes into the substation is a set of removable sleeves covering connectors arranged for disconnecting the feeder for phase testing, etc.

The newer type of substation is equipped with a four-bus direct-current switchboard for supplying a 240-volt, direct-current, three-wire system. There are three types of rotaries in the substations. The older type of rotaries has an induction regulation in the alternating-current circuit between the transformers and the rotary. The synchronous-regulator type has a rotating auxiliary winding on the alternating-current side of the armature and is connected between the rotary armature and the slip-rings. The alternating-current voltage induced in this winding by a separate field flux regulates the alternating-current voltage delivered to the armature. In the split-pole type regulation is obtained by changing the ratio between the alternating-current and direct-current voltages by varying the excitation of the auxiliary poles.

There are located in each direct-current station, as pointed out elsewhere, from one to two balancers. These machines are mechanically coupled together and electrically connected, one from the neutral to the positive bus and one from the neutral to the negative bus. By weakening the field of one it is made to take current from its side of the system and send it out by way of the other machine on the other side. As is seen by the diagram, the field coils are cross-connected.

Each substation is likewise equipped with one or more boosters consisting of a direct-current motor mechanically connected to two low-voltage generators which can be put in series with any feeder or feeders or connected from one bus to another (one on the positive and one on the negative side). It is customary in this way to operate the fourth bus on the direct-current switchboards with from one to three, and sometimes four, feeders on which the voltage may be below normal.

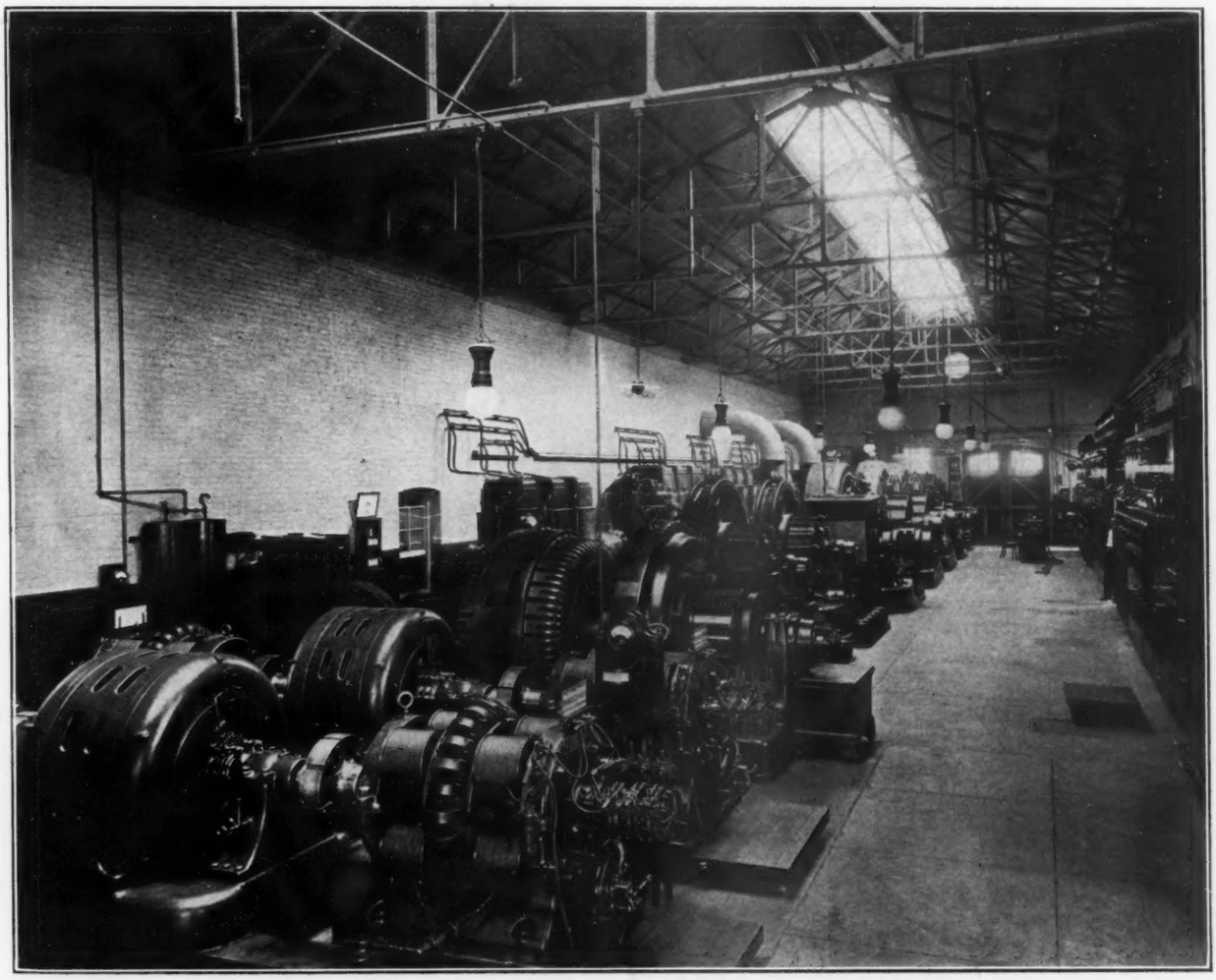


Fig. 17—General View of West Twelfth Street, Coney Island, Substation.

The direct-current feeders are equipped with pressure wires running from the points where they connect to the mains back to the substations, and are connected through fuses to a pressure-wire cabinet, on which are located voltmeters read every fifteen minutes. The voltage is regulated to correspond with a voltage curve which is furnished the operator.

If only one or two feeders drop in feeder-end voltage, a booster is started and the generators (with the field rheostats

on the weak position) are connected from No. 1 bus to a spare bus. The switches on the feeders having a low feeder end are then closed on this spare bus and opened on No. 1 bus, after which the voltage can be raised on the spare bus by strengthening the booster generator fields high enough to bring the feeder ends up to standard potential.

In the event of the feeder-end pressure on a number of feeders dropping below normal, another rotary is started and while still connected to No. 1 bus it is also connected to a spare bus, the low feeders are put on this spare bus and cleared from No. 1 bus. The voltage is then raised on the rotary until its load is equal to the load of all of the separate feeders, then the rotary is separated from No. 1 bus and the spare-bus voltage brought up by the rotary regulator to a point where all the feeders will have the required feeder-end voltage.

It often becomes necessary to transfer a feeder from a low to a high bus without affecting any others, and to accomplish this it is necessary to put the feeder on a spare bus with a rotary or booster. It is then separated from the low bus and the voltage raised to that of the high bus, after which it is tied in with the latter and the machine used to transfer the feeder can be disconnected from the high bus and shut down or used to assist in supplying this bus with energy.

In separating buses it is necessary to determine whether the separated bus will need to be balanced after it is separated from No. 1 bus or if the load is balanced well enough to maintain a balanced feeder-end pressure with the assistance received from the rest of the system through the mains. If it is evident that the bus will require balancing, a pair of 125-volt rotaries or a 250-volt rotary and a balancer are used to supply energy to this separate bus. Separating buses is avoided as much as possible, as it necessarily means the lowering of the efficiency of a substation as a distributing unit.

In the event of trouble on the direct-current system the switch of the defective feeder or feeders is opened if it is evident from the instruments that more harm than good will result from keeping the feeder in service.

A battery is continuously floating on No. 1 bus and connected to the switchboard by two positive and two negative end-cell switches, both of which are connected to No. 1 bus during the peak load in the evening. During the rest of the day only one end-cell switch is used.

A curve is provided the operator showing the voltage and number of cells required for any bus pressure in order for the battery to float on the bus without charging or discharging The specific gravity and temperature of the electrolyte are taken daily and at the end of a battery charge. The frequency of these charges is determined by the condition of the battery.

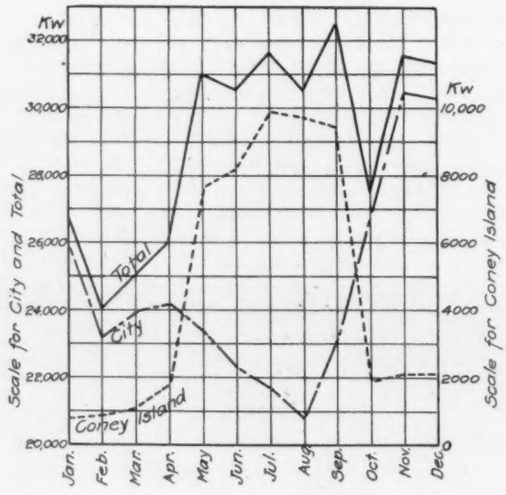


Fig. 19—Maximum Load Curve, Showing Effect of Coney Island Business.

With but two exceptions all rotaries on the system are started as direct-current motors, each station being provided with two starting boxes and a five-point throw-over switch. One of the starting boxes is held in reserve for emergency use. In starting rotary converters the operator is required to ascertain if the rotary is clear of the board and if all starting switches are opened. He then pulls the field switch into the outer clip and closes the negative machine switch on No. 1 bus. The rheostat meanwhile is placed on the full-field position. If the field coils are energized he closes the starting switch on the positive side, brings the rheostat to the short-circuit position by cutting out the resistance and closes the positive-machine switch on No. 1 bus. The field is then closed in the inner clip across the machine armature. After all starting apparatus is cleared the system operator is notified that the machine is ready to go in on the alternating-current side. With the system operator's sanction the oil switch is thrown in and the voltage on the rotary is balanced with the secondary transformer voltage by means of the alternating-current voltmeter on the board. At the same time the frequency is brought to that of the system. Synchronizing is effected by the use of lamps and the knife switches between the transformers and the rotary. The switches are closed when the light is extinguished. The load is picked up by the use of the particular regulating device for this rotary.

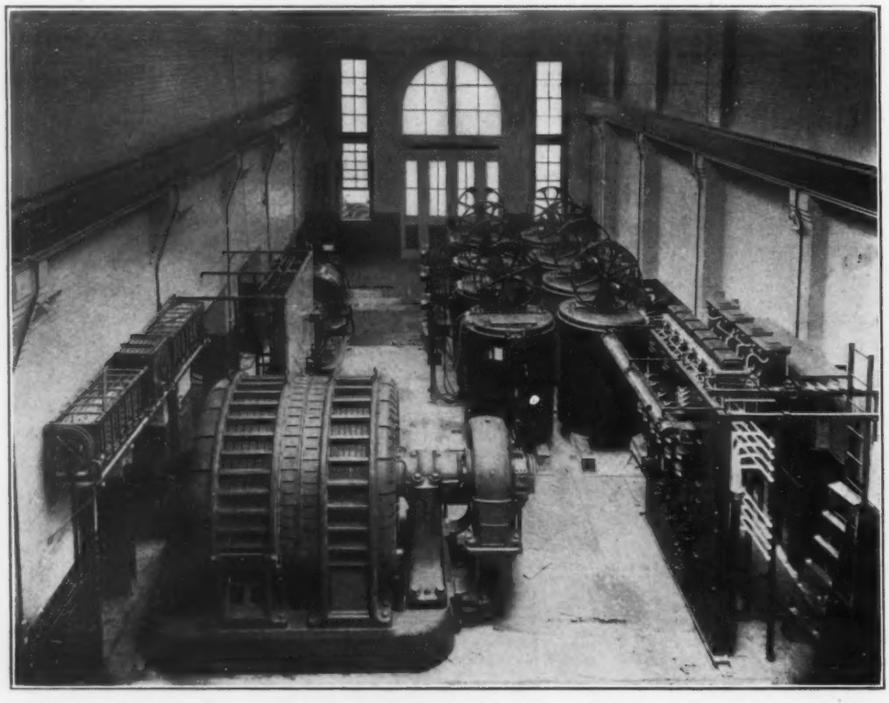


Fig 18—Sumpter Street Substation Addition.

In one of the substations, which is located in the Lidgerwood Manufacturing Company's plant, it is customary to shut down for several hours each night. In this case the rotaries, being

of only 400-kw rating, are started directly from the alternating-current side by the use of a 50 per cent tap on the secondary of the transformer. When this station was first started there was some difficulty experienced because the rotaries came up reversed. This was overcome by the installation of a 60-amp, 6-volt battery, which is connected to the field coils through a switch before the alternating-current switch is closed on the machine to start. The battery circuit is opened as soon as the machine voltmeter shows a reading.

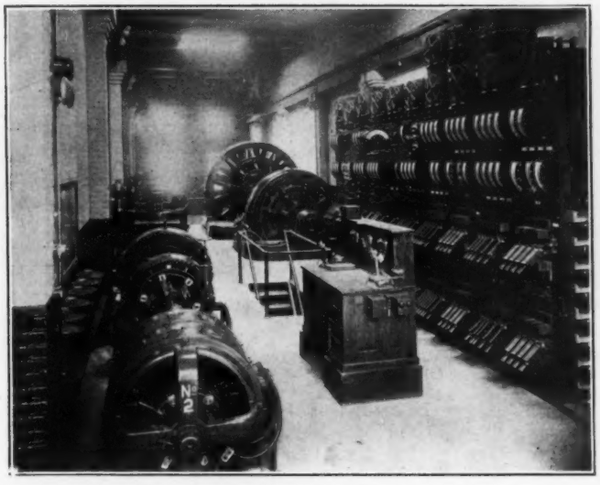


Fig. 20—Atlantic Avenue Substation.

At the West Twelfth Street (Coney Island) station there are a pair of 500-kw rotaries equipped with three-phase, 25-cycle induction motors with the rotor mounted directly on one end of the shaft. This equipment was installed for emergency purposes, it being possible in case of a complete shut-down of the station to bring these two rotaries up to the voltage on the direct-current bus in less than two minutes. This station being primarily a summer station it is not equipped with a storage battery, and in addition to the above-mentioned rotary there

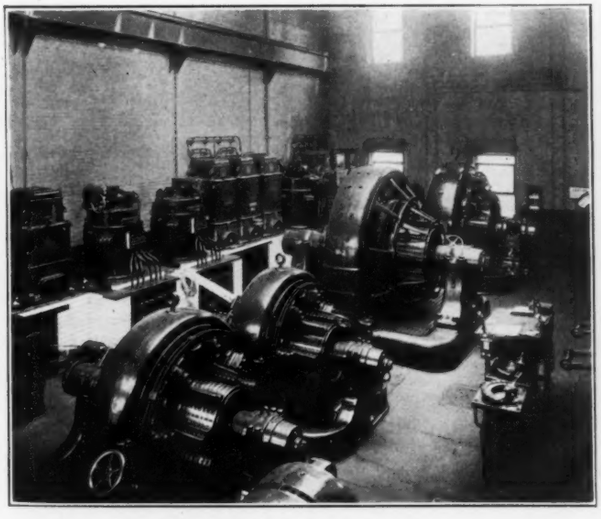


Fig. 21—Carroll Street Substation.

is a 500-kw direct-current motor-generator set driven by a 6600-volt induction motor. The generator of this set is so arranged that it can be put on either the positive or the negative side of the system for the purpose of starting either of the pair of 200-kw, 125-volt rotaries from which the remainder of the station can be started. The trouble reports show, however, that this method of starting has not been necessary during the last three years, although both methods are used in practice every Sunday morning.

CENTRAL DISTRIBUTION.

The direct-current distribution is entirely underground, the cables being installed in clay or fiber-duct subways with manholes at frequent intervals, following standard practice in this respect. A considerable amount of old Edison tube feeders, consisting of two conductors and a neutral insulated with rubber and a compound, embedded solidly in iron pipe and buried in the ground, is still in the streets, but no new feeders are installed in this system for obvious reasons.

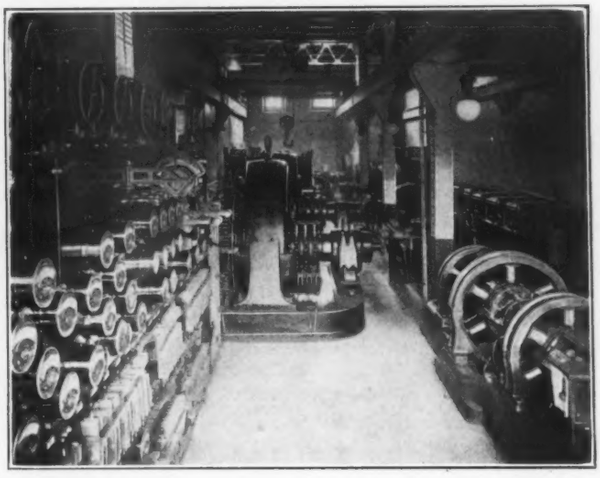


Fig. 22—Sumpter Street Substation.

The outgoing two-phase feeders are run underground in congested districts and on 45-ft. or 35-ft. pole lines in the outlying sections to transformers located to suit service conditions. Where a group of customers is to be served the secondary network is used and large transformers installed. Isolated customers, however, have individual transformers mounted on a pole near the premises. The secondaries of the transformers are wound to give 125 volts, single phase, for lamp circuits and 250 volts, two phase for motor service. The voltage on a two-phase feeder is regulated at the substation by means of contact-making voltmeters automatically operating a relay switch controlling the circuit to the motor on the regulator. The latter is an oil-cooled auto-transformer.

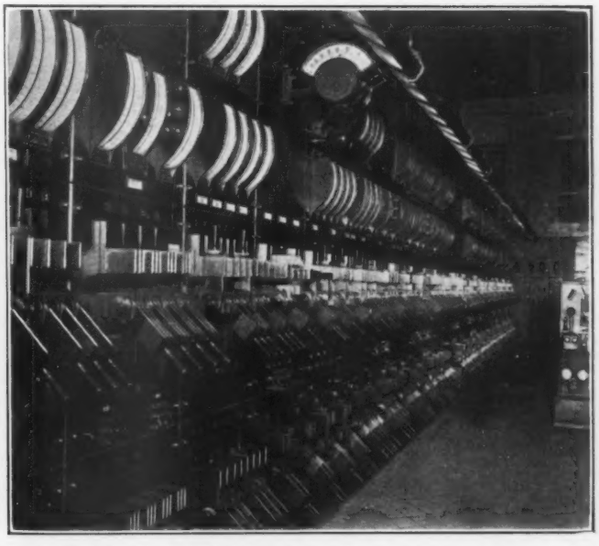


Fig. 23—Direct-Current Switchboard in Pearl Street Substation.

The service of each customer, whether in the alternating-current or direct-current district, is brought into the premises at a point mutually convenient, and the company installs a protected service switch and cut-out, together with a meter, on a board erected for the purpose. Separate meters are installed for motor and lamp circuits where these are subject to separate rates.

Fig. 24—Back-Yard Pole Line in Suburban District.

BACK-YARD SERVICE

In the high-class residential sections of Flatbush and Bay Ridge the company has standardized a back-yard service system which is operated in conjunction with the telephone company, the latter's cable taking the lower position. A 22-ft. concrete post is used for this purpose and the transformers are connected on the second pole and the secondaries extended along the poles to the end of the block, one transformer feeding a block. The primary service is brought underground to the post and up inside or outside of the post in conduit to the transformer. The service is carried from the pole to the house in standard three-conductor cable and to the meter in flexible iron conduit.

OVERHEAD SERVICES.

The following is the method adopted by the Edison company of installing overhead services: Two buck arms are placed on the pole, immediately under the lower line arm, and the transformer is hung from the upper arm, the foot of the transformer resting against the bottom arm, thus holding the transformer in a perpendicular position. The primary cut-outs are attached to the top buck arm on either side of the transformer and taps are taken from the primary line and lead in to one side of the cut-outs, the primary leads of the transformer being placed in the other. The cut-outs are equipped with inclosed fuses.

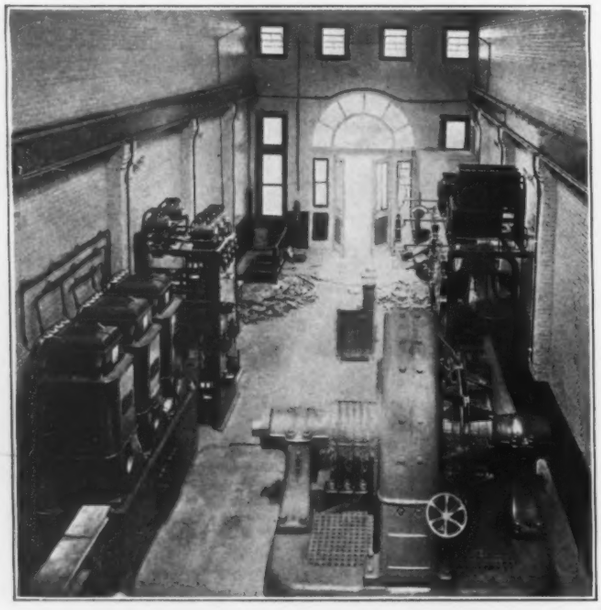


Fig. 25—Madison Street Substation.

The service cable, which consists of a twin-conductor No. 8, a three-conductor No. 8, or a three-conductor No. 4 cable (the size depending on the installation), has 3/32-in. rubber insulation around each conductor, a layer of tape and two layers of braid over all, the spaces between conductors being filled out with jute to give a round finish. The cable thus made up is carried from the pole to a point above the second-story window of the building to be served and is held rigid by being attached to an insulator on the end pin of the bottom buck arm and to a porcelain insulator and pull-off attached to an iron elbow bracket which is fastened to the face of the building with lag screws. From the point where the service cable is wrapped around the porcelain insulator to the point where it enters the building it is incased in flexible iron tubing, the tubing being attached to the face of the building with straps and entering the top of the show window in stores or the cellar window in residences. A drip loop is placed at the top and bottom of the tubing in order to prevent water entering the building. The size of the tubing used depends upon the size of the cable installed and ranges from ¾ in. to 1¼ in. inside diameter.

Fig. 26—Short-Arm Lamp-Post. Fig. 27—Long-Arm Lamp-Post.

PUBLIC LIGHTING.

The Brooklyn Edison company supplies energy to over 5000 arc lamps and 658 tungsten lamps constituting the public electric-lighting service. High-tension and low-tension, direct-current and alternating-current series and multiple circuits are maintained for this purpose. The standard size of wire for arc circuits is No. 4, and the direct-current, high-tension series-arc lamps are placed on 25-ft. or 30-ft. wooden poles or suspended from top-mast arms or from side-mast arms extending approximately 12 ft. over the street and 18 ft. above the roadway. The arc lamp used is of the inclosed type rated at 6.6 amp and 70 volts across the arc. In conjunction with these series circuits the company has installed forty-seven series-tungsten lamps consuming 6.6 amp at 11.3 volts. The circuits are supplied with energy from arc machines or mercury rectifiers at 6000 volts and 6.6 amp. The low-tension series circuits are maintained only in Canarsie and feed forty-one lamps, the energy supply being taken from a tub regulator, the primary winding of which receives energy from one phase of a two-phase primary feeder.

Low-tension, multiple alternating-current arc lamps are fed with energy from a secondary bus connected to the secondary side of a transformer. Where underground secondary mains are maintained the lamps are fed from a bus line which is itself fed through iron conduit attached to a pole, the wires in the conduit tapping the underground circuits. Multiple-tungsten

lamps are connected to such circuits in some sections of South Brooklyn.

Wherever underground direct-current mains have been installed high-tension series-arc lamps have given place to low-tension direct-current multiple lamps. These are suspended from graceful iron posts almost 29 ft. over all and set in the ground to a depth of almost 3 ft. Iron mast arms, either long

Fig. 28—Tungsten Street Lighting in Suburban District.

or short and supported by a bracket, are installed about 1½ ft. from the top of the pole. A 2-in. iron service pipe is installed between the lamp-post and distribution box and the service, which consists of three No. 8 lead-armored cables, is drawn through this pipe, connected at one end to the street mains and at the other to a magnet-control switch through a cut-out. Convenient points of control are selected for fifteen or more lamps and a two-pole knife switch is installed. From this switch a No. 8 control wire is drawn through ducts and cut in to the switch in each post to be controlled. The direct-current arc lamps are rated for 5.75 amp and 70 volts at the arc and burn 3950 hours yearly.

In Fort Greene and Prospect Parks there is a total of 840 tungsten lamps staggered along the drives and main walks. For feeding these lamps central points of distribution were located accessible to the company's feeders in surrounding

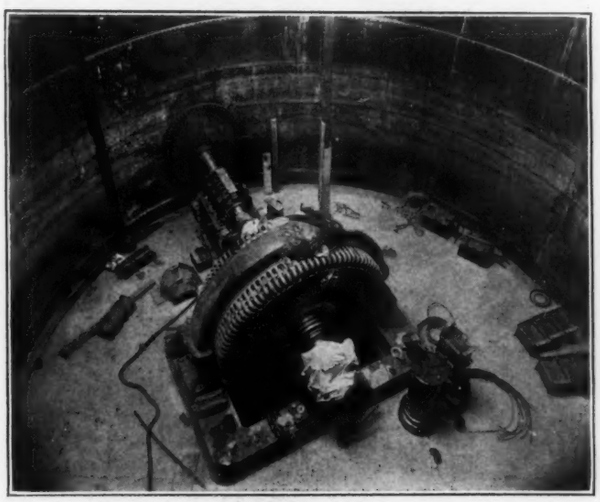


Fig. 29—Gowanus Pumping Station.

streets, small manholes and a subway consisting of one 3-in. fiber conduit constructed and feeders hauled in. Trenches approximately 6 in. wide and 8 in. deep were opened between the manhole and the nearest lamp and also between lamps. A steel-armored cable made up of three No. 4 solid conductors with 11/32-in. insulation and 5/64-in. lead sheath served with tarred jute and wrapped with two 1/32-in. steel tapes in reverse direction was laid from a manhole to the nearest post and looped in every lamp, the conductor reducing in size gradually to a two-conductor No. 8 cable. For the control of the lamps switches are located on convenient posts throughout the parks.

HIGH-PRESSURE PUMPING SYSTEM.

There are in operation in both the boroughs of Manhattan and Brooklyn electrically driven high-pressure pumping stations

Fig. 30—High-Pressure Pumping Station.

for fire service. The systems in the two boroughs are alike in all essentials. Two pumping stations, each supplying the whole system of high-pressure mains, are allotted to Brooklyn. One is located at Furman and Joralemon Streets and the other at the corner of Willoughby Street and St. Edward's Place. The equipment in the first-named station consists of five and in the second-named station of three six-stage centrifugal pumps electrically driven by 6600-volt induction motors. The pumps were built by the Worthington company and the motors by the General Electric Company. The former are designed to use either fresh or salt water, and each pump can deliver 3300 gal. of water a minute against a pressure of 300 lb. per square inch. The larger station is capable of pumping approximately 22,000,000 gal. of water a day and the smaller station 13,000,000 gal. Each pump is direct-connected by means of a flexible coupling to a 800-hp, 25-cycle, four-pole motor operating at a synchro-

Fig. 31—Electric Hoist in Subway Construction.

nous speed of 750 r.p.m. and at a full-load speed of approximately 735 r.p.m. Under its contract with the city the company must install and maintain for the exclusive use of the city sufficient generating machinery, cables, etc., to permit of the starting of any three motors in one station simultaneously. For further details regarding this system and the rates received for service see *Electrical World*, March 14, 1908.

CANAL-FLUSHING STATION

The Gowanus Canal flushing station is the latest city pumping station to be installed on the Edison service. It is located at the head of the canal at Douglass Street and a 6600-volt, 25-cycle feeder carries the necessary energy. This feeder is connected to a high-tension panel, on which are also an oil switch, series and shunt transformers, relays and meters. An-

Fig. 32—Electric Hoists Used in Subway Construction.

other high-tension board containing disconnecting and motor-reversing switches is situated near the transformers. Three Wagner oil-cooled transformers, each of 250-kva rating and connected in delta, reduce the voltage from 6600 volts to 550 volts.

A 400-hp Westinghouse induction motor is direct-connected to a 9-ft., four-blade turbine pump. The motor is wound for 550 volts, 25 cycles, three-phase and is rated at 400 amp per terminal, 120 r.p.m. at full load. A rheostat controller which varies the resistance in the rotor circuit is used for starting and regulating the speed of the motor. The latter is situated at the bottom of a metal-lined circular pit. The pit is of such a depth that the horizontal motor shaft has the same elevation as the center of the tunnel. The shaft projects through the motor pit into the tunnel and the fan-like pump, which is fastened to the end of the shaft, completely fills the tunnel. The capacity of the pump is 30,000 cu. ft. per minute. Running the pump at intervals, the entire contents of Gowanus Canal can be changed three times daily. By means of a reversing switch which interchanges two of the leads the motor and pump may be driven in either direction. The present plan is to run the pump on the ebb of the tide, when the dirty, muddy water will discharge through a large tunnel crossing the city into the East River. Clean water from New York Harbor will flow in to take the place of that removed by pumping.

Two motor-operated gates control the flow of the water. The gate in the intake tunnel is situated in a small gate house just outside the station, and the gate in the discharge tunnel is inside the station. The gates are raised or lowered by means of two vertical threaded shafts, each having a stationary pinion at its upper end. Two worm gears on a horizontal shaft drive these pinions, and the horizontal shaft is geared to a direct-current motor. The gate motors are each rated at 7½ hp, 110 volts and 850 r.p.m. A hand-operated auxiliary gate, 24 in. square, is used when starting or shutting down the station. A direct-current switchboard is situated at one end of the building. The switchboard contains the lighting panel and the control for the small motors, namely, the two gate motors and a 220-volt sump-pump motor.

SALES DEPARTMENT.

The company's sales department is splendidly organized and capable under present direction of a maximum of efficient and productive work. Commercially, the territory of the company is divided into three divisions with three offices, 360 Pearl Street, 5114 Fifth Avenue and 884 Broadway. At each one of these offices is a district manager and salesmen who report to him, a cashier who represents the treasurer, and a lamp clerk representing the lamp department. There are also appliance displays at each office.

ADVERTISING.

For ten years the Brooklyn Edison company has pursued a campaign of progressive advertising; in fact, it was one of the pioneers in central-station publicity work, and its advertisements have been reproduced and commented upon all over the country. The company has adopted as a slogan the words "Brighter Brooklyn," and this is utilized as a catch word in much of its advertising.

MOTOR LOAD.

About 40 per cent of the business of the Brooklyn Edison company is motor load, and it supplies exclusive service to a great many large industrial enterprises. For instance, the John N. Robins Company, at Erie Basin, operates one of the largest dry docks in the world. Some two years ago this company discontinued the use of its private plant and adopted Edison service for something like 3500 hp in motors. The consumption of this one installation for last year was in excess of 3,000,000 kw-hours. A complete description of this interesting installation appeared in *Electrical World*. The Bush Terminal Company, a very large dock, factory and warehouse waterfront enterprise, has an equipment in excess of 2500 hp; the New York Dock Company, 1200 hp; Morse Dry Dock & Repair Company, 800 hp; J. H. Williams Company, 800 hp; Lidgerwood Manufacturing Company, 800 hp, etc. The list could be continued at some length.

CONEY ISLAND BUSINESS.

The Brooklyn company is peculiarly fortunate in having such a development as Coney Island within its confines, and in this development the company has been one of the primary agencies. The magnificent mass illumination at Coney Island is its main attraction and is famous wherever the English language is spoken and beyond. Coney Island has been copied more or

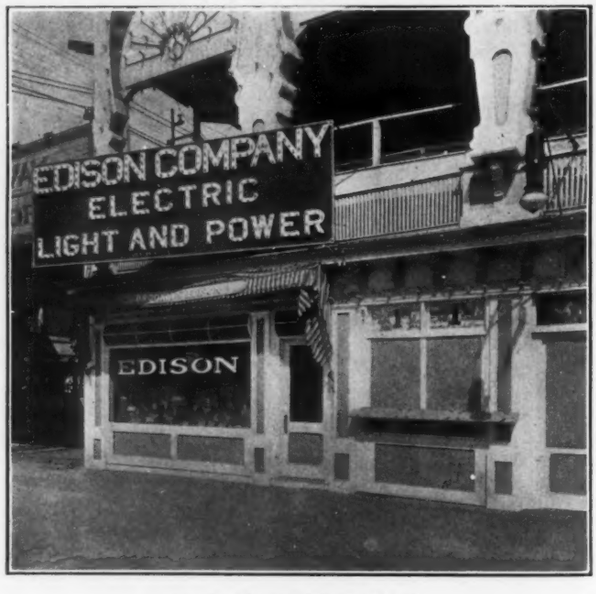


Fig. 33—Coney Island Office.

less in miniature all over the country, where there are Luna and Steeplechase Parks and Dreamlands without number. The Coney Island business of the Brooklyn company brings about peculiar and advantageous peak conditions. This business fills in the summer valley and makes the July peak about as high as that of December. Moreover, the annual peak, instead of being, as is customary with Northern central stations, in December, comes in September, when the Coney Island load, not yet

discontinued, combines with the oncoming city business. The Coney Island load reaches in the summer time as high as 11,000 kw, and this is practically all long-hour business. The company supplies electricty to all the large and small amusement enterprises of this resort. Some of the installations are extensive, Luna Park and Dreamland each taking about 3000 hp.

NATIONAL GOVERNMENT BUSINESS.

One of the large customers of the company is the United States government, the Edison company supplying a lighting service to every building on Governor's Island and the military post, which is army headquarters for the Department of the East. High-tension service is sold, the government maintaining its own cables from Brooklyn to Governor's Island and its own substation and transformer equipment. Up till five years ago this post was lighted by kerosene oil exclusively. General Chaffee, returning from the Philippines, where he found the army barracks electrically lighted, was so surprised at the backwoods equipment so near New York that he interested himself, secured an appropriation, had every building on the island wired and made a contract with the Brooklyn Edison company for the energy supply already mentioned.

The company also supplied 900 hp for the construction of Dry Dock No. 4 at the Brooklyn Navy Yard, this energy being supplied to motor-driven air compressors for the construction of caissons, which formed the foundation of the dock. This was a constant, twenty-four-hour-a-day service.

The company is also supplying service to a great many contractors for temporary work, the construction now going on including the building of the Fourth Avenue subway, a 6-mile tunnel from Manhattan Bridge the length of Fourth Avenue to Forty-second Street.

SMALL-MOTOR BUSINESS.

The small-motor business of the company is by no means neglected, as is evidenced by the fact that within the last eighteen months over 100 gas engines of from 2½ hp to 50 hp have been superseded in this territory by Edison service. Many of these are in clothing and garment-manufacturing shops. The advertising which accomplished much of this work was printed in English and Hebrew. The company pursues this policy in advertising along other lines, sending circulars in Chinese to Chinese laundries, and in other languages to races the representatives of which are frequently unfamiliar with English. This method has met with considerable success.

WIRING OLD HOUSES.

The company has accomplished a great deal toward the wiring and electrical equipment of both old and new buildings by special campaigns directed toward these ends. Some years ago when it was the exception rather than the rule for builders to wire their new properties the Edison Construction Company, whose function was to see that no building constructed in Brooklyn was unwired, succeeded in wiring 1000 buildings in eight months, and in starting the trend toward electrical equipment so strongly that it has never been found necessary to resume operations of this kind because builders and electrical contractors are now wiring practically every new building within reach of Edison mains. The present method of anticipating and developing the wiring is to solicit by means of a special corps of salesmen the wiring of both stores and residences now unequipped, to pay the contractor in full for his work and accept payment from the storekeeper or householder on the instalment plan. This system was operated for some time by means of a subsidiary corporation known as the Tungsten Lamp Specialty Company, the work of which enterprise resulted in the wiring of upward of 2500 stores hitherto illuminated by gas. The present effort under a separate branch of the sales department, known as the new-installation bureau, is being largely centered on residences and is effecting the electric equipment of a considerable number of old houses which would otherwise be many years in arriving at the point where wiring would be installed.

APPLIANCE SALES.

The sales of the appliance bureau of the sales department of the company have progressively increased, the number of articles sold in 1910 being 38 per cent in excess of the number sold in 1909. This pace has been exceeded by the results so far in 1911.

The company has just equipped a really artistic and attractive showroom at its main building, 360 Pearl Street, called and advertised as "The Edison Shop." It is one of the most beautiful display-rooms for electric appliances in the United States.

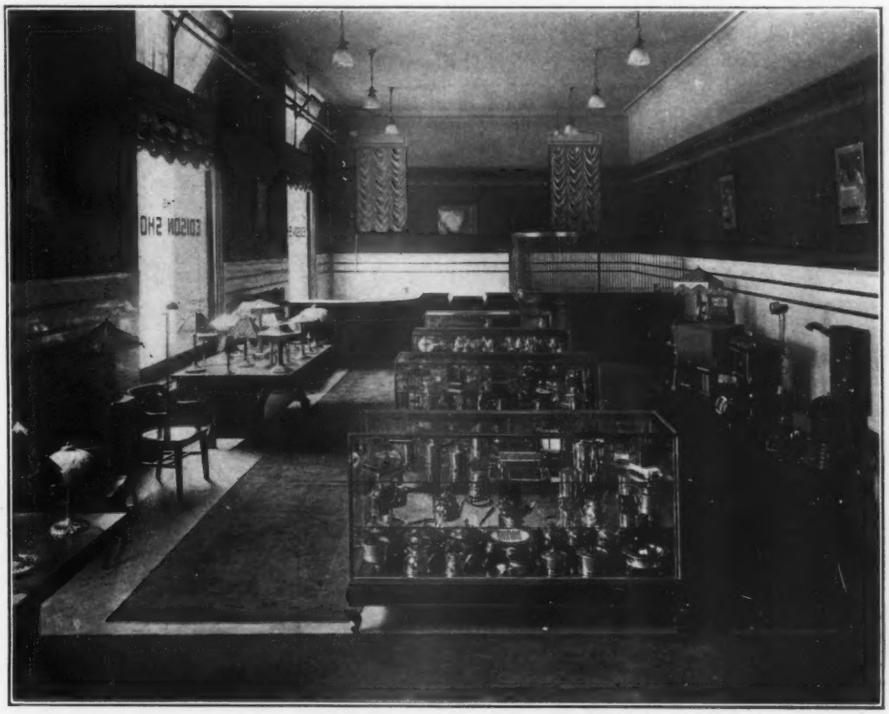


Fig. 34—Edison Shop in Pearl Street Office.

RELATIONS WITH CONTRACTORS.

The Edison company's relations with the wiring contractors in Brooklyn are very cordial. It has fostered the organization and development of an association known as the Kilowatt Club, where contractors and Edison employees meet monthly on common ground and discuss matters of general interest to both. The contractors are given a dinner annually and usually a summer outing.

WELFARE WORK.

In the welfare work which the Brooklyn Edison company has done in connection with its employees the company has taken advanced ground, and it was a pioneer in all activities of this kind. A mutual-benefit association was organized eleven years ago, the company contributing a considerable sum, and the members paying small dues which entitle them to death benefits, free medical attendance and a weekly payment in case of illness or disability. Some years later the Edison Club was formed. This is an organization maintained by the company at no expense to the employee, and is open to all who work for the

company. The clubrooms are equipped with pool and billiard tables, and there are facilities for playing many other games. A small library is maintained and there is a piano for those who are musically inclined. The Edison Club rooms are utilized for the meetings of the many department organizations, among which are included a Meter Testers' Club, an Auditing Department Council, the Fiscal Club and a Sales Department Organization. The Brooklyn Edison Baseball Club has achieved enviable reputation as a first-class and almost unbeaten team.

BROOKLYN COMPANY SECTION, N. E. L. A.

The company was one of the first to take up the company section work of the National Electric Light Association, and has now an energetic and thoroughly progressive company branch numbering in excess of 500 members. A monthly bulletin is issued by this section and it has initiated some high-class National Electric Light Association ideas as to development and co-operation.

EDUCATIONAL WORK.

The company has also, from year to year, offered its employees educational advantages by which their usefulness to themselves and to the company has been enhanced at little or no expense to them. These educational methods have included lecture courses and courses in institutions of learning. The latest plan is to offer employees a course in Pratt Institute in industrial electricity, steam engineering, mechanical engineering or mathematics. The company advances the tuition, which the employee pays back in instalments. If the student completes the course of study to the satisfaction of the education committee of the Edison company, the entire tuition fee is refunded to him.

PROFIT SHARING AND SERVICE ANNUITIES.

Propably the most notable development of its employees' welfare work was the establishment on Jan. 1, 1911, of profit-sharing and service-annuity plans. In this work, which has already been described in these columns, the Brooklyn Edison

Fig. 35—Fifth Avenue Branch Office.

company took the lead. It was the first of the large corporations to establish real co-operative profit sharing between stockholders and employees. Under this plan the employee receives a dividend on his wages equivalent to that received by the investor on his stockholdings. The conditions under which his share of the profit is received by each employee are such that he is compelled to save and become more interested in the company than he otherwise might be, by reason of the fact that he is a part owner.

Prior to the establishment of this profit-sharing system, in July, 1910, the Brooklyn Edison company started an Edison investment fund, administered for the benefit of employees without expense to them. This also has been described in the *Electrical World*. Suffice it here to say that this fund is now

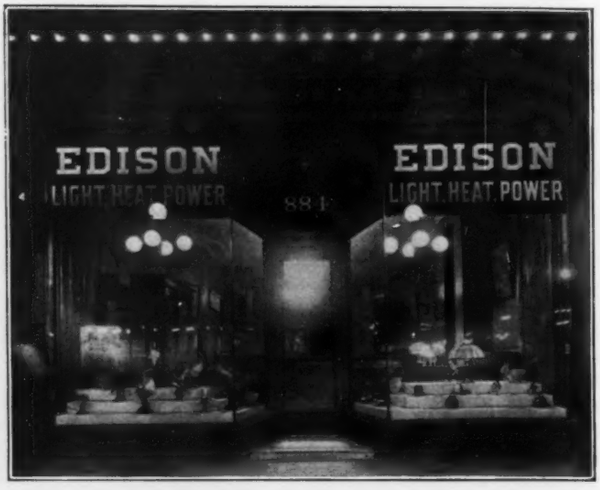


Fig. 36—Broadway Branch Office.

in excess of $100,000, all of which belongs exclusively to individual employees of the company.

EMPLOYEES' MEMORANDUM BOOK.

In connection with the commercial development of this company it may be worth while to mention the plan of the sales department known as its "Red Book." This is a pocket memorandum book, each page of which is numbered and detachable. The employee is asked to carry this with him on all occasions and put down anything that seems likely to prove of interest to the company, either in the way of possible new business, defective service or any suggestion with regard to development. These memoranda are turned into the sales department, where a record is kept of every lead and the resultant business. At the end of the year the employees whose leads have resulted in the greatest advantage to the company are amply rewarded. This plan has resulted in a surprisingly large amount of new business in addition to supplying valuable information along other company lines.

PUBLIC POLICY.

One of the factors which account to some extent for the phenomenal success of the Brooklyn Edison company is the policy it has adopted for many years in its dealings with the public. It was one of the first of the large corporations to adopt a common-sense plan of taking the public into its confidence in matters affecting business methods and operation. The following is a copy of an advertisement entitled "A Public-Service Corporation's Statement as to Business Methods and Public Policy," which appeared in the Brooklyn papers:

"The Edison Electric Illuminating Company of Brooklyn believes and acts upon the theory that any permanently satisfactory business must be built upon the basis of mutual advantage, and that this mutual advantage consists in giving the public the best service possible at a price consistent with the maintenance of such service and a reasonable profit to stockholders upon their investment. The company's securities represent capital actually invested in the business. The company's rates are so arranged as, with careful and economical administration and the maintenance of a high and even liberal standard of public service, to permit of the payment of a reasonable return on this investment. These rates differ in accordance with quantitative consumption as governed by minimum guarantees on

the part of the customer, and in accordance with certain broad divisions of application, as being, for instance, lower for motor energy than for lighting energy, but there are no secret rates and no discrimination as between customers in the matter of rates, all rates being public and the same rate being charged in every case for similar service under similar conditions."

FINANCIAL.

The Edison company has paid its stockholders a dividend of 8 per cent per annum for many years. The gross earnings last year were $4,338,987.55, which was an increase of $605,147.14 over the gross earnings of the year previous, while the operating expenses increased only $183,000. After charging more than $525,000 to depreciation and paying a dividend of over $800,000 it still had a net profit and loss surplus of $187,062.04 on the year's business, an increase of $129,496.42 over the 1909 net. The company's total assets were figured on the first of the year as $27,358,634.61.

OFFICERS.

Mr. A. N. Brady, president; Mr. A. M. Young, vice-president; Mr. W. W. Freeman, vice-president and general manager; Mr. W. F. Wells, general superintendent; Mr. P. R. Atkinson, treasurer; Mr. J. H. Evans, secretary.

BOARD OF DIRECTORS.

Messrs. Frank Bailey, William Berri, A. N. Brady, N. F. Brady, H. C. Du Val, Walton Ferguson, W. W. Freeman, Bernard Gallagher, Seth L. Kenney, Thomas E. Murray, W. F. Sheehan, J. N. Wallace and A. M. Young.

STAFF COUNCIL.

Mr. W. W. Freeman, general manager; Mr. W. F. Wells, general superintendent; Mr. P. R. Atkinson, treasurer; Mr. J. H. Evans, secretary; Mr. W. J. Ray, acting auditor; Mr. T. I. Jones, sales agent; Mr. H. P. Wood, operating engineer; Mr. J. W. Lafferty, superintendent of distribution; Mr. G. L. Knight, designing engineer; Mr. E. W. Babcock, superintendent of electrical construction; Mr. G. E. Brown, distribution engineer; Mr. M. S. Seelman, Jr., advertising manager; Mr. H. F. Frasse, purchasing agent; Mr. W. T. Fairbairn, chief inspector; Mr. William Eichert, superintendent meter department; E. A. Baily, secretary.

RETAILING NIAGARA POWER.

System of Depew and Lancaster Light, Power & Conduit Company.

By T. Croft and J. D. Mooney.

WHEN Mr. Ernest Feyler opened a dry-goods store in Lancaster, N. Y., in 1896, he wanted to be abreast of the times by lighting his store with electricity. As there was no lighting company in Lancaster, he decided to install an isolated plant in the basement of his store. When this was accomplished the other merchants in the town were so impressed with the advantages of electric lighting that they prevailed upon Mr. Feyler to enlarge his plant and supply them with energy for lighting their stores.

Business grew so rapidly that in 1898 it became necessary to secure a separate building for service as a power house. A frame building that had served as a blacksmith shop was selected and new machinery was added.

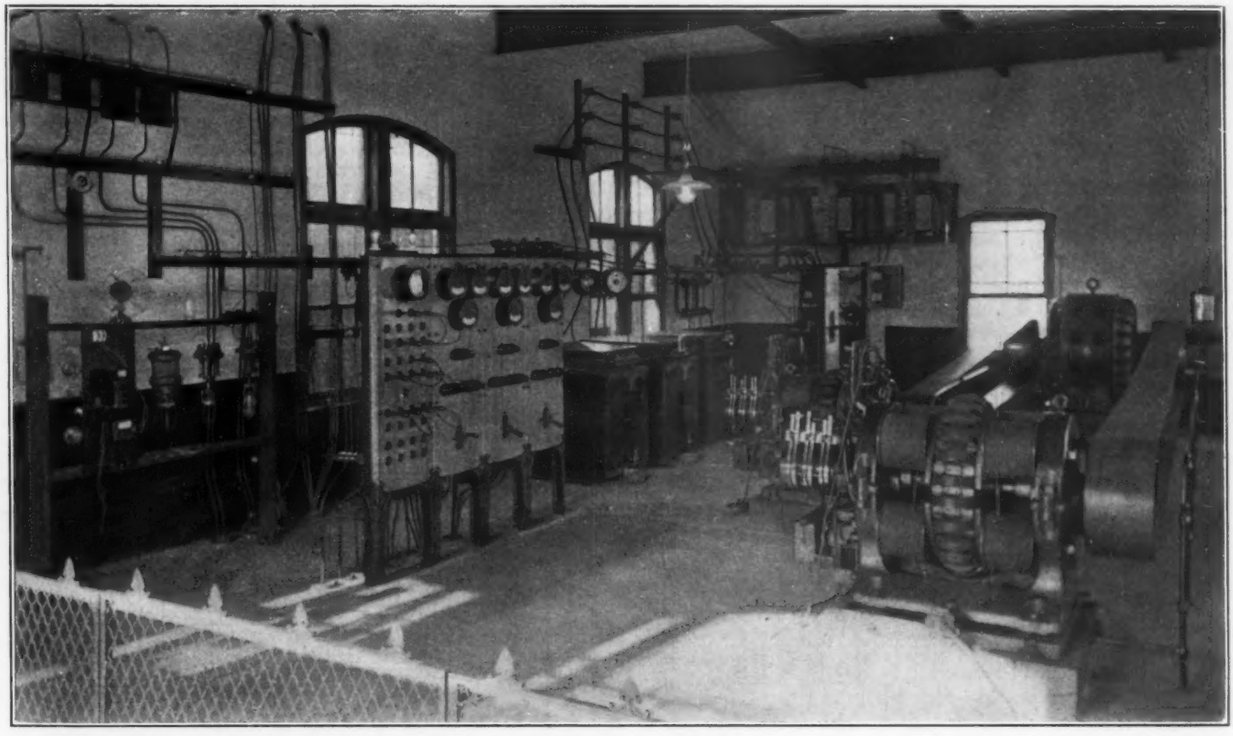


Fig. 1—General View of Generating Station.

In 1901 the Depew & Lancaster Light, Power & Conduit Company was organized, Mr. Feyler receiving a controlling interest in compensation for his plant at Lancaster. Franchises and contracts were then secured in all the intervening territory between the eastern line of Buffalo and the eastern line of the village of Lancaster, embracing two townships and three incorporated villages and covering 75 square miles. Energy was supplied for house lighting at 133 cycles, single-phase; for the series arc lighting direct-current energy was supplied by Brush arc generators. No day service was maintained.

In 1907 the company became convinced that it cost more to generate power than to buy it from the Niagara, Lockport & Ontario Power Company, which at that time was making an active campaign for the distribution of its energy. A new brick substation was built and the old arc machines were moved into this and driven by an induction motor (Fig. 1). Niagara power was received at 11,000 volts, three-phase, and stepped down to 2200 volts by means of three 100-kw oil-insulated, self-cooling transformers. A four-panel lighting feeder switch-

board was installed. Twenty-four-hour service was inaugurated at once.

Late in 1907 the company was reorganized and the services of Mr. H. B. Zimmerman as general manager and Mr. A. R. Tremaine as superintendent were secured. The new management immediately started an earnest and aggressive campaign for power business with the result that in three years' time the maximum demand increased from 225 hp to 1000 hp. In order to take care of all the power business in the territory and to avoid the duplication of lines with those of the Niagara, Lockport & Ontario Power Company it was decided to sell large blocks of power at the same voltage at which it was received.

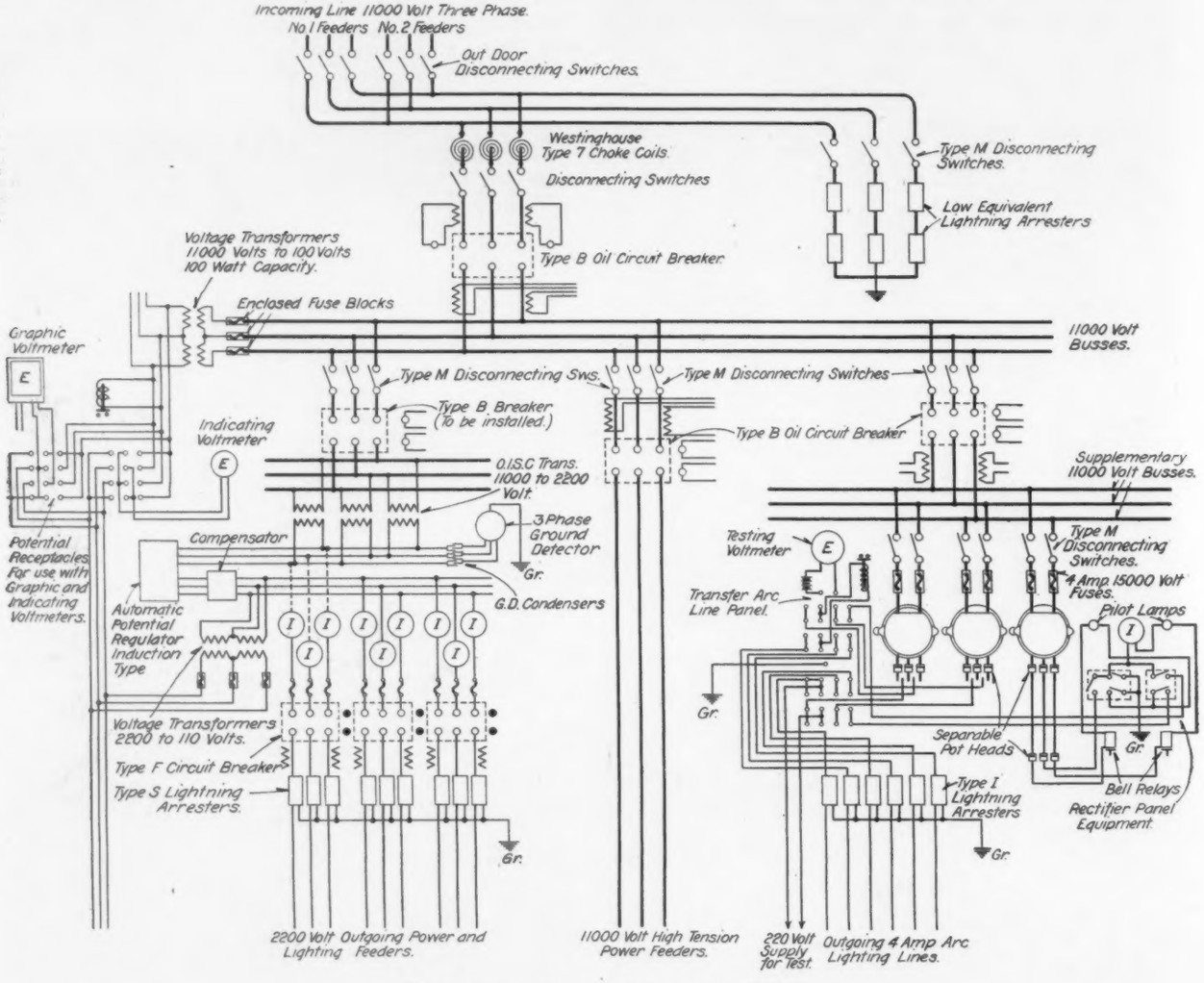

Incoming Line 11000 Volt Three Phase.
No. 1 Feeders No. 2 Feeders
Out Door Disconnecting Switches.
Westinghouse Type T Choke Coils.
Disconnecting Switches
Type M Disconnecting Switches.
Low Equivalent Lightning Arresters
Voltage Transformers 11000 Volts to 100 Volts 100 Watt Capacity.
Type B Oil Circuit Breaker
Enclosed Fuse Blocks
11000 Volt Busses.
Graphic Voltmeter
Type M Disconnecting Sws.
Type M Disconnecting Switches
Type B Breaker (To be installed.)
Type B Oil Circuit Breaker
Indicating Voltmeter
O.I.S.C Trans. 11000 to 2200 Volt
Supplementary 11000 Volt Busses.
3 Phase Ground Detector
Compensator
Testing Voltmeter
Type M Disconnecting Switches.
4 Amp 15000 Volt Fuses.
Potential Receptacles For use with Graphic and Indicating Voltmeters.
Gr.
G.D. Condensers
Transfer Arc Line Panel.
Pilot Lamps
Automatic Potential Regulator Induction Type
Gr.
Separable Pot Heads
Gr.
Voltage Transformers 2200 to 110 Volts.
Type F Circuit Breaker
Type I Lightning Arresters
Bell Relays
Rectifier Panel Equipment
Type S Lightning Arresters.
Gr.
Gr.
2200 Volt Outgoing Power and Lighting Feeders.
11000 Volt High Tension Power Feeders.
220 Volt Supply for Test.
Outgoing 4 Amp Arc Lighting Lines.

Fig. 2—Wiring Diagram of Generating Station.

Therefore a meter measuring station was erected at a tap off the Niagara lines at Borden and Raleigh roads, Cheektowaga, and the three-phase, high-tension line was extended to Sloan. At Bellevue a 10-kw transformer has been installed to supply a small community there with energy at 110 volts and 220 volts for house lighting. The village of Sloan is supplied by a 30-kw transformer in the same way.

The arc-lighting contracts in the various villages having expired on Jan. 1, 1910, it was decided to endeavor to secure new contracts permitting the use of metallic-flame arc lamps instead of carbon arc lamps. Five-year contracts were closed with the villages for the new type of lamps, the Westinghouse 4-amp metallic-flame series arc lamp.

Two 11,000-volt feeders convey energy from the Gardenville substation to the Lancaster substation. Outdoor type (22,000-volt) disconnecting switches, mounted outside of the station, are inserted in each of these two 11,000-volt feeders. The load is ordinarily carried by one feeder, but in case of interruption to service, after five minutes, the other feeder is available without notice from the load dispatcher.

A general interior view of the station is shown in Fig. 1 and a connection diagram in Fig. 2. Inside of the station all of the 11,000-volt wiring is supported on 1¼-in. pipe framework and carried on brown-glazed porcelain insulators which are held on iron pins arranged to clamp to the framework pipes. All of the 11,000-volt buses are ½-in. (outside diameter) brass tubing. All joints, taps and elbows in the buses are made with Dossert connectors.

A low-equivalent lightning arrester, part of which is visible in Fig. 3, protects the station, and choke coils are inserted between the line and the station wiring as suggested in Fig. 4. The incoming line panel, shown in Fig. 4, carries a disconnecting switch for each leg of the 11,000-volt, three-phase circuit and an automatic oil circuit-breaker. Leads from the breaker connect to what may be considered station buses. Energy, outgoing from the station, is used for three distinct purposes and hence the switching, metering and other equipment within the station naturally divides itself into three well-defined groups, viz: apparatus for 2200-volt, three-phase lighting and power service, apparatus for 4-amp series arc lighting and apparatus for 11,000-volt, three-phase motor service.

Lightning arresters, visible above the board in Fig. 6, protect the station equipment from static disturbances. In Fig. 7 is shown a view in the rear of the switchboard. It indicates the substantial methods adopted for supporting the wiring.

Where a large amount of energy is sold to a customer it is

transmitted to him at 11,000 volts. That energy transmitted at this pressure can be controlled, taps from the 11,000-volt incoming line are brought into the station and through disconnecting switches and an automatic oil switch as shown in the diagram, Fig. 2. The panel carrying these 11,000-volt switches is the center one in Fig. 4.

Energy for arc lighting is received by each of three Westinghouse seventy-five-light rectifiers at 11,000 volts and converted to direct constant current (4 amp). On the constant-potential side disconnecting switches and an automatic oil switch are inserted between the main bus and the rectifier bus, as shown in Fig. 2. The handle and face plate for the 11,000-volt switch for rectifier control are mounted on the panel shown to the left in Fig. 4. The switch itself is mounted on the bus supports in the rear of the panel. A complete diagram of the wiring at the rectifiers is shown in Fig. 2. Each of the rectifiers is connected across one phase of the 11,000-volt, three-phase circuit and a disconnecting switch and a 4-amp fuse are inserted in such of the leads to the rectifiers. In each of the three secondary (direct-current) leads from each rectifier a G. & W. porcelain separable pothead is used to connect the flexible cable of the rectifier to the varnished cambric lead-covered cable to the control panel. A pothead of this type forms a disconnecting switch inasmuch as, by taking off the top portion, the circuit is opened.

All of the 11,000-volt high-tension wiring for the rectifiers is suppported on a pipe and strap iron frame. The secondary 4-amp lead-covered cables are carried to the switchboard in wrought-iron conduit equipped with conduit outlet fittings.

For controlling the rectifiers the three panels to the left in Fig. 6 are used. Each of these is fitted with the usual ammeter, indicating lamps, testing plugs and direct-current and rectifier switches. The single-pole knife switches are connected in the relay circuits. The relays operate when the arc-lighting circuits in which they are connected open, and ring a bell and throw drops on the annunciator. The hand wheels on the rectifier panels are to be used for tilting the bulbs when starting the rectifiers. A sprocket wheel on the hand-wheel shaft at the rear of the panel will engage with a chain which will operate another shaft. This will turn the bulb-tilting shaft.

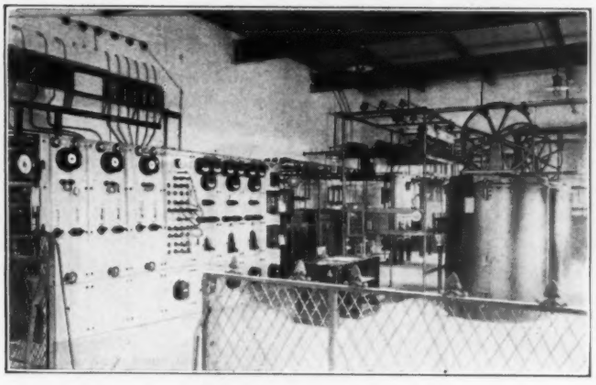


Fig. 3—View of Switchboard and Constant-Current Transformers.

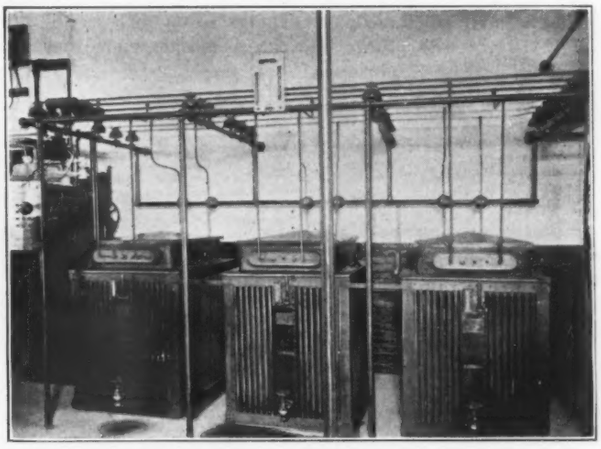


Fig. 5.—Oil-Insulated, Self-Cooled Transformers.

The arc line transfer panel (the fourth panel from the left in Fig. 3) is provided with equipment whereby the arc lines can be connected to the rectifiers and tested. Interconnection between the different arc circuits is effected with a single conductor cable having a plug at each of its ends. A relay which is connected with two jacks is mounted on this panel. During the day all of the lines are connected in series and in series with the relay. A 220-volt pressure is impressed across these lines and the relay in series and a small current flows through them. The relay is so connected with the annunciator and bell that if an open circuit occurs on an arc circuit during the day the station attendant is immediately notified by the operation of the annunciator. The testing of the arc lines and cables to the rectifiers is accomplished by means of a 100-volt battery and a 0 to 150 voltmeter. Watt-hour meters for reading the output on each feeder are mounted on the 2200-volt feeder panels, the voltage of these feeders being regulated by an automatic potential regulator, induction type. Watt-hour meters also measure the input to the rectifiers and a graphic recording and watt-hour meter is used to measure the entire input to the station at 11,000 volts. A graphic voltmeter on the board can be used for the observation of voltage on either the 11,000-volt bus or the 2200-volt bus.

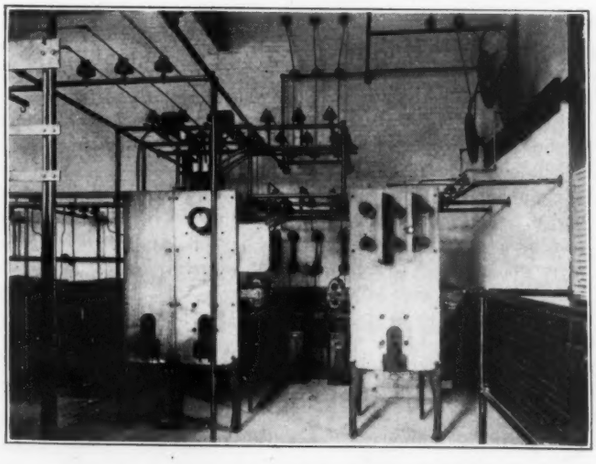


Fig. 4.—11,000-Volt Switches for Rectifier Control.

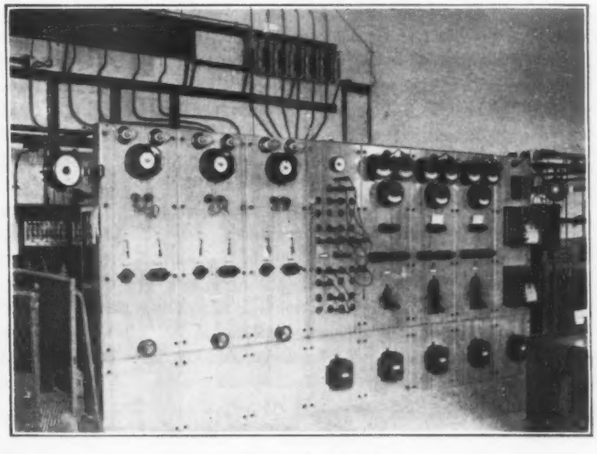


Fig. 6—Switchboard.

A new standard mast arm, illustrated in Fig. 8, has recently been adopted by the company. The new mast arms are constructed of 1¼-in. galvanized pipe and in lengths from 8 ft. to 16 ft. They are wire-braced and supported by means of galvanized steel strand fitted with eye-bolts to permit of an adjustment in all directions. The cast-iron pulleys are fitted with sheaves with bronze bearings. The lamps are supported from safety clutches insulated from the hanging rigs by Ajax lamp insulators, to which are attached insulated supports for

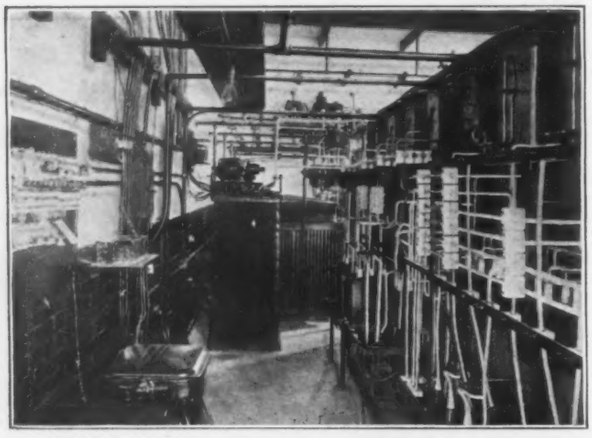


Fig. 7—Back of Switchboard.

dead-ending the No. 8 standard duplex cable. This twin cable is attached to the pole on a brown-glazed, split-porcelain insulator which extends 5 in. from the faces of the poles. The lamps are raised and lowered by a cord fastened at the ground end by means of metal rope clamps and snaps, which can be fitted with padlocks when necessary. All metal parts of the mast arms are galvanized and the construction, though light, is very strong. A feature of this construction is the wind brace used to take up the side strains.

The arc-lighting lines are divided into three circuits, all of which are No. 6 triple-braid copper, carried on brown porcelain-glazed insulators. At the point where the line loops to feed the village of Sloan, which point is located at Borden Road, an outdoor-type, double-throw oil switch is installed. This cuts out several miles of arc line and thirty lamps. The villages of Lancaster and Depew are supplied with commercial small motor and lamp service. For this service three-phase, 2200-volt energy is conveyed from the Lancaster station by two feeders. These feeders are run on extra-deep-groove, double-petticoat glass insulators to the power customers in each village. The lighting districts are fed by single-phase extensions from these three-phase feeders. The points of connection are protected by Westinghouse single-pole primary cut-outs using inclosed fuses, all metal parts being heavily galvanized. The feeders are protected from lightning by Westinghouse arresters at numerous points. Several customers on this system take power at 2200 volts and have their own transformer houses, in which lightning arresters are also installed These customers use a standard incoming line panel equipped with disconnecting switches, switchboard polyphase watt-hour meters and automatic oil circuit-breakers. The energy in all these cases is measured on the 2200-volt side. All the power service below 10 hp is supplied at 220 volts, either single-phase or three-phase, according to the character of the load. No three-phase motor service is given below 5 hp unless there are other three-phase motors already in use in the same district.

The standard form of line construction with arc lamp and commercial circuits includes 10-ft., 10-pin cross-arms, these in all cases being above the telephone wires. These arms carry the arc, 2200-volt, and 220-110-volt secondary lines. Service wires are run direct from the arm by means of two-wire and three-wire spreader brackets. In the commercial districts the three-wire secondary is fed in separate sections by single transformers, but these sections can be multipled in case of necessity by means of jumpers, as the end of each secondary section is dead-ended on an iron break-arm, bringing the ends of the two sections about 1 ft. apart. During the winter load these ends are sometimes connected together through a single-pole fuse block, thus putting the two transformers in multiple and help-

Fig. 8—Standard Arc-Lamp Mast Arm.

ing to divide the lighting load on the transformers. The single-phase load is balanced as near as possible at the point of attachment of the single-phase extensions.

In June, 1910, the Depew & Lancaster Light, Power & Conduit Company entered into an agreement with the New York Telephone Company for the joint use of poles. The agreement covers all lines in this territory, and as a result of its terms the lighting company eventually will have all its wires above the telephone wires. The specifications forming a part of this agreement are the same as those in effect between the Public Service Corporation and the Bell System in New Jersey. Work is progressing rapidly toward bringing the construction into accordance with these specifications and this work will be completed by the fall of this year. This means that practically all equipment inside and out has been replaced or renewed by the new management. All engineering work and construction work was done by the company and under the direction of Mr. Tremaine, the superintendent. The construction is model throughout. Nothing is being left undone by the management to give the best possible service to customers, and this progressive policy has won for the company a very friendly feeling in the community it serves.

The company has a neat office building which is divided into a main general office, back of which is the general manager's and directors' room and beyond that the superintendent's room and meter-testing department and storeroom. This arrangement makes for convenience and permits everything to be handled in the most efficient manner.

CONNECTICUT RIVER ENERGY IN WORCESTER.

SINCE the completion of the first plant of the Connecticut River Transmission Company at Vernon, Vt., the supply of hydroelectric service in central Massachusetts, and particularly in Worcester County, has well illustrated the immediate acceptance which low-priced energy finds in a manufacturing community. Eight units of an aggregate rating of 20,000 kw have now been installed at the Vernon station, from which energy is transmitted to Brattleboro, Vt., at 19,000 volts, and to Winchendon, Gardner, Fitchburg, Leominster, Clinton, Sterling, West Boylston, Marlboro and

Worcester at 66,000 volts. The engineering details of this system have already been described in this journal. The high-tension transmission is effected by means of conductors of copper, No. 2 B. & S. gage, carried on 35-lb. porcelain insulators supported on steel towers. Exclusive of a branch line to Fitchburg, there are now about 885 towers on the system, giving an average spacing of 410 ft. between towers, although there is a maximum span of 1940 ft. over the Wachusett Reservoir near Clinton.

Substations are now located at Gardner, 1500 kw; Fitchburg, 4500 kw; Clinton, 4500 kw, and Worcester, 4500 kw. The Fitchburg service now includes the three mills of the Parkhill Manufacturing Company, 1920 hp; the seven mills of the Crocker-Burbank Paper Company, 1400 hp; the De Jonge Paper Company, 900 hp; the Fitchburg Gas & Electric Light Company, 1000 hp, and the Falulah Paper Company, 500 hp. At Clinton the company supplies the Lancaster Mills, 4000 hp, and the Marlboro Electric Company, 800 hp. As the plant of the Lancaster Mills operates at 40 cycles and the frequency of the Connecticut River system is 60 cycles, two 1500-kw motor-generator sets are installed to change the frequency. The motor end of each unit operates directly on 13,200-volt feeders at 60 cycles and the generators operate at 600 volts and 40 cycles. The motors are of the synchronous type and can be used in reverse operation as generators if desired.

At Worcester the company has a substation in the Greendale district equipped with three 1500-kw transformers stepping the main transmission potential from 66,000 volts to 13,200 volts. Both transmission circuits enter all stations and the switching arrangements provide for throwing the load on either of the two lines without interrupting service. All substation switches are electrically operated by current received from storage batteries. Normally the Worcester load is carried on one transmission line and the Gardner, Fitchburg and Clinton load on the other, although the lines can be paralleled at each substation and the load transferred during normal operation without interruption to service. The transformers are of the oil-cooled type, with motor-driven water circulation and a city supply for emergency use. At present four aerial, three-phase circuits leave the Greendale substation, two running into the city of Worcester proper, one to the Osgood Bradley Car Company and one to the Town of West Bolyston, supplying the community with energy for street lighting and for miscellaneous service. The two circuits running into the heart of the city of Worcester are carried to a terminal house on Brookfield Street, where the underground cable system begins and where lightning arresters and switching devices are protecting, testing and interconnecting the circuits and cables. From the substation to Brookfield Street, a distance of 2.8 miles, the two feeders are of No. 2-0, B. & S. gage, stranded copper wire, on a wooden pole line, with space for two additional cross-arms if future business demands.

From the cable station at Brookfield Street two No. 4-0, three-phase, paper-insulated cables are carried underground to the North Works of the American Steel & Wire Company, a distance of about 2400 ft. A No. 1-0, three-phase, paper-insulated lead cable is carried underground from the North Works of the wire company to the South Works at Quinsigamond, a distance of 3.07 miles, in the conduits of the Worcester Electric Light Company, which are leased for the purpose. Under a ruling of the Massachusetts Gas & Electric Light Commission the transmission company is required to confine its sales of electricity to consumers of 300 hp rating or over in the cities of Worcester and Fitchburg, leaving the small power field to the local companies in each case.

The equipment of the principal mills in Worcester supplied by the Connecticut River Transmission Company is as follows:

South Works, American Steel & Wire Company:

One 800-kw motor-generator set taking current at 13,200 volts and delivering it at 250 volts, direct-current service, for general purposes, and one electric furnace for steel making, which consumes from 1500 kw to 2000 kw. In this furnace molten metal from the wire company's open-hearth furnaces is used in about 8-ton charges. Three electrodes, each consisting of four 8-in. carbon sticks, are automatically fed into the metal and current at 100 volts is maintained for periods of from sixty to ninety minutes, during which time various fluxes and alloys are added. It is reported that the quality of steel from this furnace is superior to that of the basic furnaces and that the refining is effected in much less time.

North Works, American Steel & Wire Company:

Two motor generators are installed of 1300-kw total rating. Each motor receives alternating current at 13,200 volts and the generators deliver it at 250 volts, direct-current service, operating in parallel with the existing steam-engine plant.

Norton Grinding Company:

This company has fifteen motors installed, ranging from 7.5 hp to 100 hp and rated at 415 hp total. The motors drive lathes, planers and other shop tools, both the individual and group drives being used. The maximum demand averages 250 hp and the daily load-factor about 56.5 per cent in this installation.

Bradley Car Company:

This plant is equipped largely with the individual motor drive. The connected load is 1535 hp, composed of ninety-eight motors ranging in size from 2 hp to 300 hp. The Bradley company has found a material saving in power to result from the use of individual motors, as throughout practically the entire plant power is consumed only in proportion to the work actually being performed. The average load is about 500 hp and the daily load-factor 60 per cent. The Connecticut River Transmission Company makes a practice of carrying its feeders to the premises of consumers and requiring them to install all apparatus for their local needs. Disconnecting switches are installed usually at the entrance point of each customer's service, with both integrating and graphic recording wattmeters for each consumer. About 4000 kw in synchronous apparatus is in service on the system and the power-factor at Vernon is about 90 per cent. A contract has recently been made with the Metropolitan Water & Sewerage Board for the output of the hydroelectric plant which will shortly be built at the Wachusett Dam in Clinton, where water is delivered to an aqueduct for the Boston supply. It is planned to install four 1000-kw generators here. As the reservoir is usually drawn upon in the summer, the power can be used at times when the Connecticut River is likely to be low. Interests associated with the Connecticut River Transmission Company are preparing to develop about 50,000 hp under 800 ft. head on the Deerfield River, and it is probable that the two systems will in some measure be co-ordinated. The writer is indebted to Mr. E. J. Richards, general superintendent of the Connecticut River Transmission Company, for the information which is contained in the foregoing article.

STONE LAMP-POSTS IN BLOOMINGTON, IND.

Stone lamp-posts for a rather extensive curb-lighting system form a unique feature of the attractive city of Bloomington, Ind. These posts are not concrete, but are made of natural limestone. This limestone abounds in the neighborhood of Bloomington, and several companies located there are engaged in producing and milling it. Fig. 2 of the accompanying illustrations gives a perspective view showing the appearance of a double line of these posts along a business street.

When it was decided to install a new system of curb lighting the committee in charge of the matter considered at first, as was natural, the installation of ornamental iron posts. The new lighting system was one outgrowth of a public demand for civic betterment, and on investigation it was found that the cost of an iron post of handsome design, such as was wanted, would be too great. It was desired to make the system of lighting uniform, and as the population of Bloomington is only about 10,000 the expense must not be prohibitive. To insure uniformity it was agreed that the city should have sole charge

of the new lighting, both as to installation and in relation to future extensions.

Another objection to iron posts that was urged was that they were not impressive or particularly beautiful by daylight. While the type and design of the posts were under consideration someone suggested that they be made of the Indiana limestone,

Fig. 1—Night View of Curb Lighting in Bloomington, Ind.

with the marketing of which the city of Bloomington is closely identified. This was considered a happy thought, and after some discussion was finally adopted. As shown by the pictures, the posts are dignified and impressive in appearance and they also serve to direct attention to a leading industry. About 120 of the posts are in service, each surmounted, as shown, by a globe containing a 40-watt tungsten lamp and supporting a crosspiece to which two dependent lamps of similar type are attached.

In making the installation the steel-taped cable made by the Simplex Electrical Company was found to be particularly convenient. One notable feature of the installation is that the 120 posts were erected and made ready for lighting service without placing a single conduit box or joint under the pavement. This was made possible by the construction of the stone posts, which have a section of the base sawed out large enough to permit both ends of the cable to be looped into this space, thus allowing the lamps to be connected and the other end of the cable to be continued on to the next post. This space in the base also contains the fuse box. The sawed-out block in the base can be taken out and replaced in a few minutes. The space in the base of the post makes it possible to do away with a conduit

Fig. 2—Stone Lamp-Posts in Bloomington, Ind.

box in the gutter, and this cuts down the cost of installation materially.

At the time the erection of the posts was under way the streets were being paved with brick. This pavement was laid on a concrete foundation 8 in. deep, over which was placed sand 2 in. deep, the top surface consisting of brick. A 2-in. pipe was pressed into the concrete while it was being laid and was later removed, leaving a depression nearly 2 in. deep in the hard concrete. The posts are spaced 55 ft. apart, and this distance was measured off, allowing about 8 in. of cable to protrude above the sidewalk. The cable was then laid in the depression in the concrete and the only covering over it is the 2 in. of sand and the brick surface of the pavement. The cost of the cable used was 20½ cents a foot. It was necessary to have two pairs of wires, as the lamps are on two circuits. With one circuit the price of the cable would be reduced to 12 cents or 13 cents a foot.

The stone posts illustrated herewith cost $35 each in Bloomington and each one weighs about 800 lb. Aside from the posts the cable and the cast-iron shade holders (the last named costing 35 cents apiece), the rest of the fixture was made with ordinary iron pipe and pipe fittings. In future, however, galvanized-iron pipe and fittings will be employed.

All three lamps on the posts are burned from one-half hour after sunset until 10 p. m. After 10 o'clock the top lamp only is burned, remaining lighted until one-half hour before sunrise. This splitting up of the lighting is made possible by the two-circuit system. The lamps are controlled from the central station, and electricity is supplied by the Central Indiana Lighting Company, Bloomington division, of which Mr. J. N. Moncrieff is manager. The expense to the city for operation is $1 per post per month. This does not include the cost of maintenance, which is assumed by the local Commercial Club. This lighting system was in operation nearly all of the winter of 1910-1911, and it has required no attention aside from the renewal of a few lamps. Na cracking or injury to the stone posts from frost has been experienced.

CONCRETE TUNGSTEN LAMP-POST.

The accompanying illustration shows a 12-ft. concrete lamp-post used for park illumination at Oklahoma City, Okla. The post carries one 100-watt and two 60-watt tungsten lamps on its cap, which is of hammered and soldered sheet copper. The shaft is made hollow to admit the wires and to decrease the weight of the material needed. The mold used is in two halves, which open to release the post after the concrete has hardened.

Tungsten Lamp-Post of Concrete.

The core used to make the internal opening is given a slight draft so that it can be withdrawn as soon as the concrete has set sufficiently to hold its own weight, but before hardening has advanced very far. The cost of making these posts was $4 each for the concrete shaft alone, the post fitted with sheet-copper cap costing $8 complete.

EXPERIENCE WITH CONCRETE POLES AT OKLAHOMA CITY.

Since 1907 nearly 1000 concrete poles have been erected in Oklahoma City for the distribution lines of the local central-station company, and after an experience with this form of construction concrete poles have been adopted there as standard construction for all principal lines. The poles used in Oklahoma City are of a locally designed hollow type, the feature of which is the tension under which the reinforcing members are placed and afterward maintained in the hardened pole. While the first cost of these concrete poles is about 50 per cent more than that of similar wood poles, the depreciation on the former is practically nil.

The majority of poles in Oklahoma City are of the standard 35-ft. type shown in Fig. 1. These poles are hexagonal in section, 16 in. in diameter at the base and 7 in. at the top, have walls approximately 2¾ in. thick and weigh 2000 lb. each. The internal opening varies from 9 in. at the base to 2 in. at the top. They are set in the ground to a depth of 6 ft. The cross-arms are of steel angles, 2½ in. x 3 in. x ⅜ in., through-bolted to the flat side of the pole through holes cast in the concrete at the time of pouring. Additional holes can easily be bored wherever desired. Steel pins with wood tops are used to carry the insulators.

The poles are poured in models made of ¼-in. galvanized iron, a concrete mixture of one part cement, two parts sand and three parts crushed stone being used. The outer mold, as shown in Fig. 2, is made in two halves, which can be opened to release the finished pole. The core forming the tapered internal opening is arranged to telescope within itself, and must be withdrawn as soon as the concrete has set sufficiently to hold its own weight, otherwise if allowed to remain too long the core may be rigidly held by the concrete.

Running through the full length of the pole above described are twelve ¼-in. twisted or deformed reinforcing bars. The pole is poured with each of these rods under a tension of 11,000 lb., this tension being maintained throughout the setting of the concrete so that in the hardened pole the bars are still continuously subjected to this tension. During pouring the tension is applied by an arrangement of ratchets and screw threads, the reinforcing bars being kinked through hardened-steel tension eyes, which grip them. This tension is not released until the concrete has hardened sufficiently to support the strain itself. The use of the reinforcing bars in tension has been found to improve greatly the performance of the poles, and this application of tension, together with the construction of the molds and cores used for pouring the concrete poles, is the subject of several patents issued to Mr. F. H. Tidnam, general manager of the Oklahoma Gas & Electric Company.

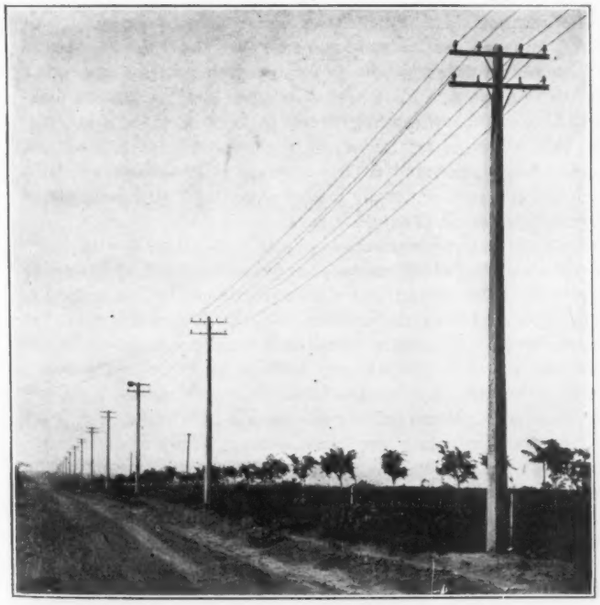


Fig. 1—Hexagonal Hollow Concrete Poles in Oklahoma City.

The actual manufacturing cost of the 35-ft. pole is $8.50 at Oklahoma City, where cement costs $2 a barrel. The set of forms for such a pole cost about $45. A gang of five concrete men can turn out from seven to eight poles per day, using fourteen forms. The number of cores need be only about half the number of forms, as the cores are pulled as soon as the concrete is partially set. The concrete poles are erected by special derrick wagons, the number of men required in a gang being the same as would be needed for equivalent wood poles. The concrete poles are climbed by extension ladders which can be adjusted to the height of the pole.

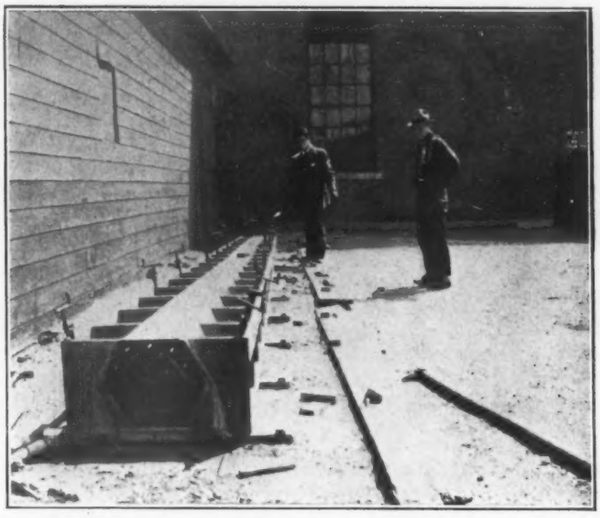


Fig. 2—Concrete Pole in Mold.

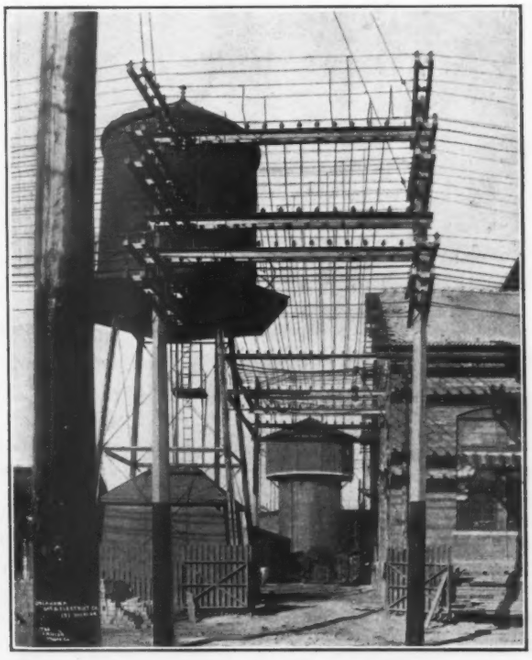


Fig. 3—Concrete Poles at Line Entry to Power House.

Tests of these poles in position, applying 1500 lb. stress to their tops, have shown a possible 2½-ft. deflection without

giving way. The poles will safely withstand a horizontal stress of 1500 lb. at the cross-arm height, it is declared. The above test was tried on newly made poles, and the results would probably be much better in the case of older poles, since concrete hardens with age. Evidence of the strength of these concrete poles to bear heavy overhead construction is shown in Fig. 3, where two 40-ft. poles are illustrated carrying weights of 4000 lb. per pole, made up of No. 000 copper feeder cables, angle arms, guy tension, etc. The example shown is the feeder exit from the power plant of the Oklahoma Gas & Electric Company.

Use is also made of the hollow interior of the poles to bring down 2300-volt lines to underground distribution cables, and also, in residence sections, to run down to underground service lines leading under lawns, etc.

Fig. 4 shows the typical concrete-pole alley construction adopted in Oklahoma City, where all distribution lines, so far as possible, are removed from the main streets. Thirty-foot concrete poles are used, carrying 20-ft. steel arms in the case of 18-ft. alleys. Twenty-five-foot concrete poles are also used

Fig. 4—Distribution Line Carried on Concrete Poles with Steel Arms.

to a limited extent in Oklahoma City and cost $6 each to manufacture. A number of 30-ft. poles with 8-in. tops, constructed by an adaptation of the 35-ft. forms, have been used for trolley-bracket suspension. Twenty such poles along an interurban railway track have been in service six months.

The first concrete poles were erected in Oklahoma City in 1907, and these, after four years' service, show no visible depreciation. To settle the question of whether any moisture could penetrate through the concrete, affecting the steel reinforcing, several of these early poles were taken down and broken open. Examination showed the interior of the pole to be absolutely dry and the steel unchanged. Owing to the hardening of the concrete with age, the poles tested actually stronger after a few years' service than when green. Mr. G. M. Brown, superintendent of lines for the Oklahoma Gas & Electric Company, believes that, while the concrete poles used in Oklahoma City cost perhaps 50 per cent more than wood poles, the fact that those of concrete show no measurable depreciation after long use makes them in the long run really cheaper to install than short-lived wood poles.

SOME NOTES ON THE LIMITATIONS AND ADVANTAGES OF HYDROELECTRIC POWER.

By Clarence P. Fowler.

I. LIMITATIONS.

1. *Development Cost.*—Over-optimism on the part of some consulting engineers as to the possibilities of water-power and a failure to recognize some of its limitations as to expenditures necessary to render it useful have resulted in "tying up" no small amount of capital invested in partially completed undertakings of this character. It also not infrequently happens that after a development has been made to take care of some predetermined amount of primary power it is finally discovered, owing to variable stream flow, that the estimated amount of power can be depended upon continuously only by incurring considerable additional expense for providing auxiliary power to make up whatever deficiency is found to exist, thereby increasing both fixed and operating charges and curtailing the margin available for profit originally estimated upon.

The possibilities of water storage have also, in many instances, been pointed out without due regard to the vast sums often required for the erection of suitable works for impounding sufficient water to equalize an otherwise variable stream-flow. Even with the addition of storage reservoirs it is found that silting up of the storage space, a characteristic of rivers in some localities, causes no small amount of expense at intervals to relieve this difficulty.

2. *Proximity to, Extent and Nature of Market.*—There are some cases where the development of hydroelectric energy has attracted industries to such centers, a notable example of which exists at Niagara Falls, where the number and extent of industrial enterprises which have grouped themselves about the great water-power plants there have reached vast proportions. The causes, however, which have been active in locating these industries at the Falls have not been exclusively cheap electric energy, but this essential element in combination with unexcelled transportation facilities by both land and water and a large part of the consuming population of the United States and Canada within a comparatively short radius.

The position held by the developments at Niagara is, of course, unusual, and hydraulic power is for the most part found in remote localities which, owing to topography and other adverse conditions, do not lend themselves well to the establishment of ideal manufacturing sites. In general, then, it is apparent that water-power is subject to limitations as to location, and if energy generated from waterfalls is to become available for industrial uses it usually means electrical transmission over a greater or lesser distance.

While elaborate mathematical demonstrations as to the maximum distance to which energy can be economically transmitted have formed the subject of no little discussion before engineering societies and in the columns of the technical press, yet this matter in the present state of the art boils down in the final analysis to a problem the solution of which falls easily within comparatively well-defined limits determined by engineering and commercial considerations peculiar to the local conditions surrounding any given case. With a given percentage of profit the distance that may economically intervene between the point of generation and that of utilization depends principally upon the total amount of energy that may be marketed, considered in connection with the unit price that may be obtained through its sale, as the following concrete example will show.

Let it be assumed that 10 per cent is the minimum profit allowable upon the total investment after deducting operating expenses and depreciation. Let it further be assumed that the hydroelectric development would require a capital expenditure in generating and receiving plant of $200 per kilowatt delivered, and that 20,000 kw can be sold at an average price of $45 per kw-year with operating expenses at $12 per kw-year. The gross receipts would, therefore, be $900,000 with operating expenses of $240,000, leaving net earnings available for profit

and depreciation of $660,000. If depreciation be figured at 3 per cent on the total investment, this item, together with 10 per cent profit on the capital cost of generating and receiving, amounts to $520,000, thus leaving $140,000 available for profit and depreciation on the capital expenditure for transmission purposes, which would permit of an expenditure of something over $1,000,000 for this end of the undertaking. If, now, the transmission system can be built at a cost of, say, $5,000 per mile complete, it will be seen that it would be possible to transmit the above energy over not more than 200 miles under the assumed conditions. Twenty thousand kw is about the maximum amount of power that would probably be advisable to "tie up" in one line, and this gives a reasonable regulation at standard frequency and with limiting line voltage now in use and with load power-factor not below that commonly encountered in such systems.

It is evident, then, that if energy from remote waterfalls is to compete successfully through the medium of electrical transmission with energy locally generated, one of the chief essentials is that the former shall be generated and transmitted in large blocks, a condition which often precludes the possibility of economically developing a water-power.

The nature of the power load as measured by load-factor forms quite an important element in determining the value of hydroelectric energy, as compared with energy generated in steam-electric plants. In large steam-driven electric plants operating at low load-factors of some value in the neighborhood of 20 per cent or below it is the rule to find that this method of energy production outstrips its hydroelectric competitor in the matter of cost. However, as the load-factor increases above a certain value hydroelectric energy shows up to better advantage, this, of course, being due to the fact that the cost of hydroelectric energy is practically fixed and independent of the amount used, whereas in the case of steam-produced power a much larger proportion of the operating expenses depends upon the consumption.

3. *Reliability.*—While the reliability factor of the generating and receiving apparatus of hydroelectric plants is equal to or better than that of the apparatus composing their hydroelectric competitors, and while transmission construction has attained a substantial basis, reliability of the latter being much enhanced by the use of duplicate lines, yet where it is necessary to transmit energy over long distances to reach the market, the importance of which demands uninterrupted service, reliability is a characteristic of the system which should receive careful attention and to insure which large expenditures in reserve equipment at the receiving end of the transmission system are regarded as a necessary adjunct to any well-planned enterprise.

4. *General.*—In summarizing the principal limitations characteristic of plants for the production of hydroelectric energy, enumerated above, the writer cannot do better than quote from the report of Mr. T. C. Martin on the "Technical Aspects of Central Electric Light and Power Stations," 1907, included with the special reports on this topic by the Department of Commerce and Labor of the United States. Of hydroelectric enterprises Mr. Martin has the following significant statement to make: "In every part of the country where water-powers lay undeveloped enterprises on a large scale have been set on foot for the purpose of hydroelectric generation and energy transmission. In fact, the period from 1902 to 1907 may be regarded as one of great speculative activity in this respect, with the result that many plants have come into existence that remain unprofitable, either because the work has been too costly, because there is little market for the energy when developed or because the problems of economical and uninterrupted transmission have not been mastered."

II. ADVANTAGES.

1. *Comparative Freedom from Interruption Due to Strikes and Fuel Supply.*—Owing to the comparatively small number of wage-earning employees required for the operation of hydroelectric plants, together with their freedom from difficulties of fuel supply incident to strikes on railroads and at coal mines, freight congestion, etc., steam-electric energy suffers in comparison with hydroelectric energy in reference to the ability of the latter to produce a non-interrupted revenue. Large investments in fuel are therefore unnecessary with hydroelectric plants to tide them over an emergency in the shape of a fuel famine. In this connection it is interesting to note that one of the largest public-service properties in the Middle West finds it necessary for a precaution against interruption of fuel supply from any cause to carry about 180,000 tons of coal in storage, which amounts to about two months' supply. Even when conservatively estimated this amount of coal represents a large amount of idle capital "tied up" to insure continuous operation.

This necessity on the part of steam plants for comparatively large amounts of working capital as compared with hydroelectric plants gives the latter quite a strategic position as compared with the former and is of great importance, particularly in times of financial stringency such as were experienced in 1907.

2. *Operating Ratio and Depreciation.*—Quite an advantageous operating characteristic of well-managed hydroelectric plants, as compared with steam-electric plants, is the relatively large increase in gross receipts without a corresponding increase in operating expenses, thus cutting down the operating ratio. As illustrating this feature there is given below a five-year statement of the ratio of operating expenses to gross receipts of a well-known hydroelectric development.

Year of Operation.	Operating Ratio in Per Cent.
1	53.5
2	32.4
3	30.0
4	23.0
5	23.0

During the five-year period tabulated above the gross receipts increased from approximately $110,000 to $460,000, while the operating expenses increased only, approximately, from $58,000 to $108,000.

Owing to the relatively large proportion of total investment in hydroelectric enterprises devoted to construction of a more or less permanent nature as compared with the equivalent steam plants, the amount that is necessary to set aside annually to cover depreciation of plants of the former type ranges probably from not more than one-third to one-half of that required for plants of the latter class.

3. *Competition.*—The measure of success with which hydroelectric energy will meet in competition with steam energy locally produced will depend largely upon the price of steam fuel in the particular locality in question, together with the possible economies attending its use. Our principal fuels are wood, oil and coal. Wood is now almost a thing of the past, and oil, although used somewhat extensively in some parts of the country, is of limited occurrence and ere long may cease to be an important element as a source of energy. Coal is therefore our chief remaining steam fuel, and as coal advances in cost hydroelectric energy furnished under proper conditions promises well to hold its own with energy generated from our most important remaining combustible.

4. *Hydroelectric Development as an Aid in the Conservation of the Fuel Supply.*—That general interest in conservation on this continent has been aroused is evidenced by the attention deservedly given this topic by the federal governments of both the United States and Canada through the formation of conservation commissions. The proposed program of these commissions is very comprehensive in scope, including, as it does, the conservation of all the principal elements of natural wealth as represented in the forests, water-powers, mines, agricultural resources, fisheries and game, and there now exists

a society for promoting the conservation of human life through encouragement in the use of safety appliances. While need doubtless exists for husbanding our natural wealth along all lines above indicated, yet not one of the least urgent of these is the necessity for some prompt measures to check the rapid rate at which our coal deposits are being depleted. United States governmental statistics show that since early in the nineteenth century the average yearly coal production of this country practically doubled each decade, and will, it is estimated, reach the average yearly value of approximately 550,000,000 tons in 1915.

There is perhaps some hope that engine economy may be improved to a slight extent and probably boiler economy to a greater degree, but the demand for fuel is accelerating too vigorously to expect material relief due to any refinements along this line. One must then naturally look for a fuller realization of the conservation ideal to a more general use of the energy of the falling water in the various watercourses.

The most advantageous method of conserving the water-powers is, of course, to use them, and stimulation in such use has been largely brought about through improvements in high-tension transmission coupled with the exhaustion of our fuel supply, and as time goes on increased activity may be expected, and many hydroelectric developments which may now not be considered commercially feasible may then be undertaken, provided legislation does not operate to retard such enterprise; in any event, increase in the number of such developments will naturally be most active in those localities where fuel is scarce.

Even during the past few years the two forces above referred to have been doubtless responsible for the increased development and use of hydroelectric energy. As bearing upon this situation, during the period from 1902 to 1907 the special reports of the Department of Commerce and Labor on "Central Electric Light and Power Stations" record some interesting statistics showing the states in which the most marked gains in rating of hydroelectric plants at the two periods above named occurred. They are given in the first table in the next column.

The special reports above referred to and the reports of the same department covering street and electric railways give the combined output of stations for traction, electric light and motor service in 1907 as approximately 11,000,000,000 kw-hours, of which about 25 per cent, or 2,750,000,000, was generated by water-power. The coal required by the average steam plant which would be used if this water-power were not available would probably amount to 5 lb. per hp-hour, or, roughly, 6½ lb. of coal per kw-hour, or a total annual fuel consumption of about 9,000,000 tons of coal, which, at say $3 per ton, represents an annual monetary saving in the value of our coal deposits of $27,000,000.

State.	Horse-Power Rating of Hydroelectric Developments.	
	1902.	1907.
New York	128,785	305,950
California	78,933	208,444
Oregon	11,195	102,052
Michigan	16,085	85,738
Minnesota	6,040	71,656
South Carolina	10,415	75,430
Washington	17,238	56,118
Montana	24,000	56,987
Georgia	6,121	36,335

Further, it is roughly estimated that in the different regions of the United States there may be ultimately available the following amounts of power:

	Horse-Power.
New England, ultimately available	1,500,000
Great Lake region, ultimately available	4,000,000
Piedmont region on Atlantic and South Atlantic slopes, ultimately available	3,000,000
Central North west, ultimately available	1,000,000
Rocky Mountain and Pacific regions, ultimately available	5,000,000
Total	14,500,000

For the sake of conservatism, suppose that 30 per cent of the above amount of power, owing to commercial or engineering reasons, is unfit for development, leaving 70 per cent, or about 10,000,000 hp, available for use. This would then be equivalent to about 75,000,000 tons of coal annually, which would be effective in lowering the estimated yearly average production of the decade ending 1915 by about 14.5 per cent.

Central Station
Management, Policies and Commercial Methods

WEEKLY ELECTRICAL PAGE IN LOUISVILLE NEWSPAPER.

With the issue of May 13 the Louisville *Times* began its second season's publication of a weekly electrical page, following generally the plan used at Cleveland, Ohio. The page carries popularly prepared reading matter on electrical subjects, together with the advertisements of local electrical companies, including the two local central stations, the jobbers, supply dealers and contractors. This weekly page feature is carried for thirteen issues during the slack summer months, when, however, construction and building operations are at their height. The arrangements have been undertaken and carried out by the advertising department of the newspaper, which has, however, the advice and suggestions of local electrical men in the selection and preparation of the reading matter. The starting of the second season of this co-operative advertising in the *Times* indicates that the plan is considered a successful one in Louisville.

DETECTING THEFT OF ELECTRICITY BY REMOVAL OF NEUTRAL FUSE.

A common way of preventing a three-wire meter from registering is to remove the neutral fuse plug, which de-energizes the potential or shunt winding. Energy for 220-volt loads or balanced 110-volt loads is then furnished over the outer wires, without registration by the meter. A means of detecting this kind of theft, in which the meter is usually stopped during only a portion of the month, was suggested by Mr. F. R. Cutcheon, electrical engineer for the St. Paul Edison Light & Power Company, at the Minnesota Electrical Association convention, St. Paul, March 14. The speaker proposed the insertion of an electrolytic-cell element in the shunt-coil connection of suspected meters. The amount of metal that should be deposited on the cathode plate by the shunt current in thirty days being known, it would be easy to estimate the time during which the meter had been out of service by weighing the plate at the intervals of the inspector's calls.

DEMONSTRATION OF CENTRAL-STATION DEPENDABILITY.

At 9:05 p. m. on May 11, while 600 of the leading business men of Louisville, Ky., were present at the annual meeting of the Commercial Club, held at the Galt Hotel (the electric service for which is supplied from an isolated plant), the lamps, which had been dim all evening, suddenly became dark, leaving the assembly room without light. Fortunately the hotel was supplied with standby service from the central station of the Kentucky Electric Company, and as soon as the double-throw switch could be operated the light came on again, this time bright and steady. The incident naturally made an impression upon the business men present, and the electric company took advantage of the interest created to print advertisements in the local papers next day explaining what happened and how the adjournment of the meeting was avoided.

A number of private-plant owners have since made inquiries about central-station service for their own buildings, so that the incident is likely to bear fruit for the electric company. Every man in the room received an impressive demonstration of the dependability of central-station service.

EMERGENCY CENTRAL-STATION SERVICE.

The Piano & Organ Supply Company, of Chicago, which manufactures and repairs piano actions and other musical supplies, has operated its factory electrically for a number of years, generating its own energy in a private plant of about 400 kw. One of the two directly connected generating units was put out of service by the breaking of an engine shaft a few days ago, and as the other was not large enough to carry the load the company faced a partial shutdown. In this emergency the owners appealed to the Commonwealth Edison Company, which met the situation by installing a temporary plant consisting of a 200-hp, 440-volt alternating-current motor belted to a 175-kw direct-current generator, which, with the effective unit of the old plant, carried the load. It was necessary to install service lines for several blocks and to secure apparatus quickly to make the alternating current available for the direct-current motors in use in the factory. The Piano & Organ Supply Company was greatly pleased with the promptness of the central-station company, and it is now figuring on taking out all its direct-current motors, putting in alternating-current, 220-volt motors and relying on the central-station service exclusively. The load consists of about 1000 incandescent lamps and thirty-three motors, having a total rating of 740 hp. Another Chicago factory where central-station service has supplanted an isolated plant recently is that of the Friedley & Voshardt Company, maker of metal ceilings, where about 750 incandescent lamps and 225 hp in motors are in service.

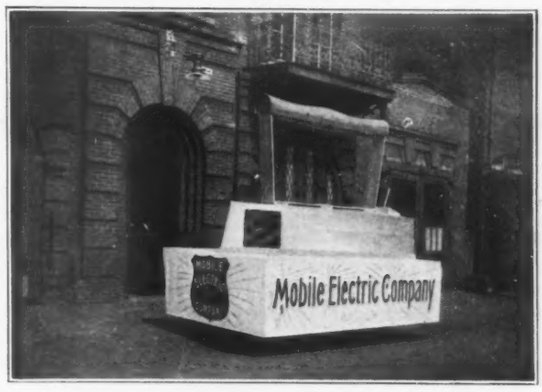
REPORT-BOX SYSTEM FOR PLANT ENGINEERS.

To make sure that the chief engineer in charge of each eight-hour shift gets over the plant at regular intervals the Brush Electric Light & Power Company at Galveston, Tex., has installed telegraph-report boxes throughout the station, which the engineer must pull at one-hour periods. There are six of these boxes in the 4300-kw steam-turbine plant. One is at the rear of the boiler-room, near the blow-offs and other piping; one in front of the boilers; two in the plant basement, and one at each end of the turbine-room. The boxes are connected to the local American District Telegraph watchmen's service, and record is made there of each box as it is pulled. Starting on the full hours the chief engineer is required to pull the boxes, for which he alone has the key, in a prescribed order and at intervals of from one to two minutes. In case any call is not received within six minutes of the appointed time the telegraph company dispatches a man to the plant to investigate, and the cost of this trip, 50 cents, is charged against the employee requiring it. The omission is also reported to the general manager, who requires an explanation from the engineer. The regular inspection of the plant by the responsible engineer of the watch, as secured by this pull-box system, has resulted in improving the maintenance and operation of the plant to a marked degree, and has also served to detect a number of minor irregularities during the hours of 6 p. m. to 6 a. m., when the report system is in operation. Owing to the presence of the service the insurance companies have reduced their charges 10 per cent.

A system of checking employees' time is also in use at the Galveston station by which each man signs his name on a paper roll on which are punched the minute, hour and date. All employees are required to sign this record when they come on or go off duty. Those who cannot write are provided with a rubber stamp. From this employment roll complete records are made up covering each man's time with the company, so that his record is evident at a glance. The signature scheme of time checking also insures the proper computation of the payroll, and in case of an accident is useful in proving what employees were on duty at the time.

AN ELECTRIC COMPANY'S PARADE FLOAT.

The accompanying illustration shows the self-propelled float of the Mobile Electric Company in the trades parade during the recent Mardi Gras celebration in that city. One of the company's electric runabouts was used, and upon this, at a cost of less than $30, was built a huge representation of an electric iron, the light boards being covered with canvas painted with aluminum bronze. The iron was complete with attachment plug. The float, which attracted considerable attention as it rolled through



Electric Automobile Float in Mobile's Mardi Gras Parade.

the streets by unseen power, was steered and controlled by a man in the vehicle seat, who peered ahead through a transparent window near the point of the iron. The annual Mardi Gras celebration is an interesting characteristic of Mobile's history, the observance of the carnival customs having taken place there earlier than in any other American city. The Mobile Mardi Gras parades are also noted for the mechanical features of their displays.

KEEPING DISTRIBUTION SYSTEM RECORDS.

A paper by I. L. Craig, of the Citizens' Gas & Electric Company, of Waterloo, Ia., read before the Iowa Electrical Association convention at Davenport, April 19, described the system of keeping records of that company's distribution system. The first demand for such records, he said, comes from the office, where new prospects are daily making inquiries as to where service is available. However, such records demand most attention because of their engineering value. All proposed extensions and additions may best be planned with their aid. For example, in Waterloo the question of readjusting

the arc-lighting load came up. By reference to records they were enabled to tell just what lamps could be changed from the overloaded circuit to the other, and, moreover, they discovered these changes could be made so as to shorten the circuits by nearly a mile of wire.

To obtain these records a map of the town was cut up into sections of convenient size, each section being mounted on cardboard or stiff paper. On these sectional maps each circuit is shown with red ink for the primary line, small crosses for lightning arresters and small circles for transformers. The secondary lines are drawn in green ink, with a solid line for three-wire secondary and dotted line for two-wire secondary. All special features are denoted on the map. In checking over transformer lists which had been kept on cards they were found out of date and a recanvass of the system was made by going up the pole to each transformer and taking from the name plate the size, manufacturer's number and primary and secondary voltages. It is especially important in Waterloo to keep the ratio of primary and secondary voltages correct on the records because the ratio 10 to 1 is used near the power plant and 9 to 1 at the ends of feeders on motor circuits.

Sizes and lengths of wires on the different circuits were reported by making a diagram of a pole top in a notebook, each wire being indicated and named with the size specified. The notes specify where the pole is located and for how many poles the pole-top arrangements remain the same. In getting wire measurements it is not necessary to climb each pole, but follow the circuit until a splice occurs, which is readily noticed.

After getting the three different sets of field records together the information is assembled into circuit maps. These maps are all drawn at a scale of 300 ft. to 1 in. If the tracing of a circuit map is laid over a city map of the same scale the lines will fall in their correct position with regard to the streets and alleys. Suitable symbols and a key to the symbols complete the map. A map on a smaller scale is made for the information of the new-business department.

RECIPROCAL LIABILITY INSURANCE FOR SMALL PUBLIC-SERVICE CORPORATIONS.

Insurance companies which make a business of protecting corporations and individuals against liability for injuries to employees and the public at large are said to expend at least 55 per cent of their premium receipts in obtaining this business and administering their own affairs. Even then their net income is slight after paying losses, the result being that in some districts the companies are reported to have ordered an increase of 33 per cent for all renewals of policies.

A plan for reciprocal liability insurance among a number of small central stations, avoiding the heavy business-getting and administrative costs of the regular companies, besides instituting better inspection and a more careful selection of risks, was outlined by ex-Judge Daniel G. Taylor, of St. Louis, before the Missouri Electrical Association April 13. According to his plan, which differs from mutual insurance in having no common fund, each subscriber would pay into the exchange or "attorney" a "deposit" equal to his present annual insurance rate. This amount would not be turned into a general fund, but would be credited to the individual company's account, and then in case of loss on the part of another subscriber a proportional amount of the first subscriber's deposit would be utilized to pay indemnity. All deposit money remaining in the attorney's hands unneeded for damages at the end of the year would be returned to the individual subscribers after deducting the small fixed percentage earned by the central office for administering the business. Judge Taylor declared that at least 30 per cent might be expected to be returned and saved for the companies in this way. In case of excessively heavy losses on the part of its subscribers, the membership might be called upon for additional emergency deposits up to the amount of the annual deposits. The liability, however, is thus individual and there is no general fund. While this inter-insurance plan is new to the public-service corporation field, Judge Taylor declared that other interests have employed it to advantage for some time. The lumbermen, he said, have effected a saving of 30 per cent by means of substituting it for old-line liability insurance, and the laundrymen have registered savings up to 50 per cent.

The advantages offered by such a plan to the small public-service company, he said, would be the avoidance of the usual heavy business-getting and administrative costs, for which a smaller fixed sum would be substituted, while the contributing risks would be better selected and maintained by careful inspection. Interest earnings would also be saved to the member companies.

COMMERCIAL EDUCATION OF CENTRAL-STATION SOLICITORS.

A commercial education for new employees who aspire to become salesmen for public service companies is being recognized as one of the problems which all large corporations must solve as best fits their own particular requirements. The New York Edison Company has been the first central-station company to begin preparations for the establishing of a school which is to be confined to its contract and inspection department.

Other corporations of large magnitude have, however, given considerable thought and attention to this subject. For three years past the Consolidated Gas Company has maintained a school or courses of instruction along technical lines. The courses taught have been mostly "trouble cases," teaching the employee how to locate and remedy quickly the various causes of trouble which the company is called upon to correct, such as a fallen chandelier or a leaking gas pipe, etc.

About five months ago the New York Telephone Company began in a small way to school its new employees who were to be placed in the commercial field. The employee is placed on salary and is sent to "school" for a period of five weeks. The schedule of the school courses is varied and includes such topics as "scope and policies," "duties of departments and their relations," and, of a more specific nature, general instructions divided into courses under the headings of "traffic," "plant," "auditing" and "commercial." Mr. F. W. Hearne, who is directly in charge, states that the results so far have been satisfactory. A total of 102 men has been schooled, out of which ninety-nine have "made good" in their positions. The telephone company is not satisfied, however, that it has yet perfected the ideal courses of instruction. An objection which has been raised is the shortness of the term and the constant cramming of information into the student's mind without sufficient time for assimilation.

The New York Edison Company has not as yet perfected its school. Many ideas have been suggested and a few practically decided upon as advantageous. The courses should be conducted on the university plan; lectures, recitations and examinations, with the asking and answering of questions. For textbooks its solicitors' handbook and the National Electric Light Association solicitors' handbook are considered to be desirable.

There are thirty-one subheads or bureaus in the contract and inspection department, and lectures will be delivered by those in charge of these bureaus. There will also be lectures on salesmanship by men outside of the company who have been successful as sales managers. This is done to broaden as much as possible the scope of the school. Company policy is to receive careful consideration.

A corporation grown large and practically handling the entire business in its field must not forget that its representatives, so far as the public is concerned, are the men by whom the company is judged. The salesmen and inspectors daily come in contact with the public, and the customers expect these representatives to be thoroughly competent to answer every question,

and that their answers shall be intelligent. The public holds the company to a strict accounting for any statements which its representatives make. Thus the absolute necessity that the company's representatives should thoroughly understand the company's policies and methods.

Under the old plan a young man came into the company as a record clerk. If he was ambitious to be a salesman he worked his way up through a certain department, and, although he might understand thoroughly the requirements of that department, he may not have understood the many other requirements of the company or the duties which he assumed upon advancing into his new position.

CENTRAL-STATION THEATRICAL ENTERTAINMENT.

After months of preparation the Edison Players' Club of the Commonwealth Edison Branch of the National Electric Light Association presented a musical farce in two acts, entitled "The Mickey-Doo of Titti-Poo," at Orchestral Hall, Chicago, on the night of May 10. The production was elaborately staged and went off smoothly, being greatly enjoyed by an audience of about 2300 persons. About ninety persons took part in the performance, and all of them, both men and women, were employees of the Commonwealth Edison Company, the operetta being a strictly company-talent performance in every sense. The music and libretto were strongly reminiscent of Gilbert and Sullivan's "Mikado," but only as a groundwork, being so modified with original lyrics and "business" that the result was quite a different production. Two of the songs were "A Very Subtle Essence Known as Electricity" and "An Electrical Betrothal," the whole concluding with a rousing chorus, "N. E. L. A."

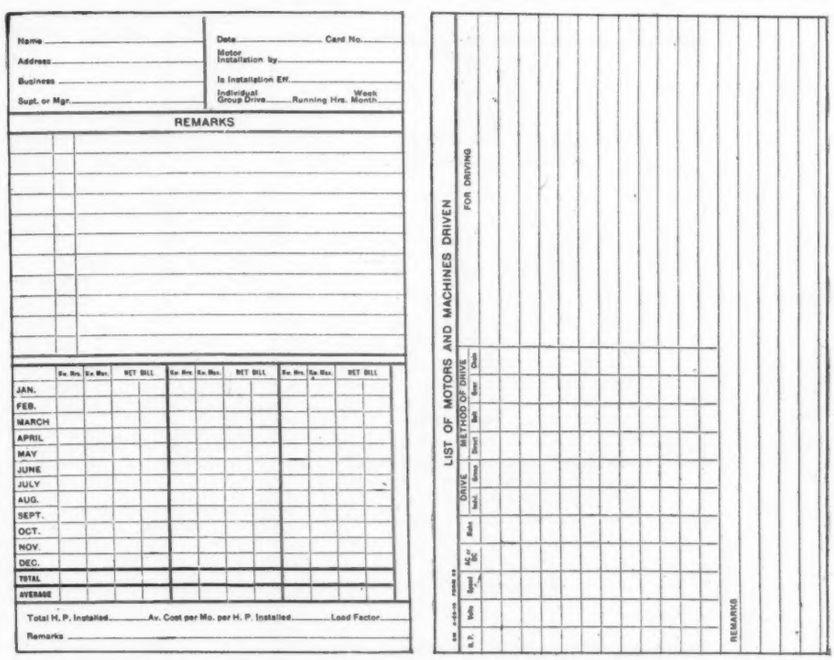
A unique feature of the entertainment was the erection of a burlesque central-station plant on the stage, which finally "went out" with an explosion at the switchboard resulting in the injury of one man, who received most amusing first-aid attentions. The scenery, costumes and electrical effects were original and elaborate. The printed program, too, was provided with an original cover design and many amusing notes and burlesque "ads," the whole being the work of Edison men. Where so many were engaged in an elaborate performance it would be invidious to single out any for praise, but it can be stated truthfully that the whole entertainment was a great success and in a high degree creditable to all who took part in it. The cast of the principal characters was as follows: *Mickey-Doo,* Mr. Michael F. McGovern; *Nanki Poo,* Mr. William R. White; *Koko,* Mr. William C. Berry; *Pooh Bah,* Mr. Harold Wright; *Pish Tush,* Mr. Willard H. Childs; *Yum Yum,* Miss Barbara M. Kuehn; *Pitti Sing,* Miss Kathleen M. Hartigan; *Peek Bo,* Miss Mae L. Leffingwell; *Katisha,* Mr. Henry E. Addenbrooke.

During the evening a telegram was received from President Samuel Insull in New York, who was disappointed in being called away by an imperative business engagement. Mr. John F. Gilchrist, assistant to the president, also out of town, sent a telegram of good wishes. After the theatrical performance there was an informal reception with refreshments, and the evening concluded with dancing.

The occasion served to reveal the existence of decided musical and dramatic talent among members of the large Commonwealth organization, and it also demonstrated in a striking manner the remarkable solidarity of this company, all present entering into the evening's merry-making like the members of one great family. A large number of ladies were present, as many members of the branch brought their wives, sweethearts or relatives. The entire organization of the company, from the president down, was greatly interested in the affair, and the company appropriated a large sum of money to assist in meeting the rather formidable expense involved. The general committee consisted of Mr. L. A. Ferguson, chairman; Mr. E. F. Smith, vice-chairman, and Messrs. J. F. Gilchrist, W. A. Fox, R. F. Schuchardt, H. L. Gannett and E. A. Edkins. The performance was staged under the direction of Mr. William C. Berry.

MOTOR-INSTALLATION RECORD CARD.

The accompanying reproductions show the form of motor-installation record card employed in the offices of central-station properties managed by H. M. Byllesby & Company, Chicago. These 8-in. x 5-in. cards are adapted for filing horizontally in standard cabinets—for easy finding the name of the installation being entered along the narrow blank tab at the right, opposite the monthly columns. This enables any card to be located quickly by running through the file. As soon as a motor prospect is located all available information about his installation is entered in the blanks provided on the card, so that the file gives complete data regarding prospects as well as existing installations of motors. After the prospect has become a customer, his monthly consumptions, demands and bills are all entered in the blanks, which provide for three years' records. These results are then totaled and averaged, and average costs, load-factors, etc., figured. The load-factor is always taken based on the twenty-four-hour schedule, so that the figure is not open to misunderstanding due to the length of working day, etc. The assembly of complete records and data on a single card in this way is found of great utility to solicitors and to the office staff in the case of both customers and prospects, making available all the facts of a given installation by reference to a single card.



Front and Back Sides of Motor Installation Record Card.

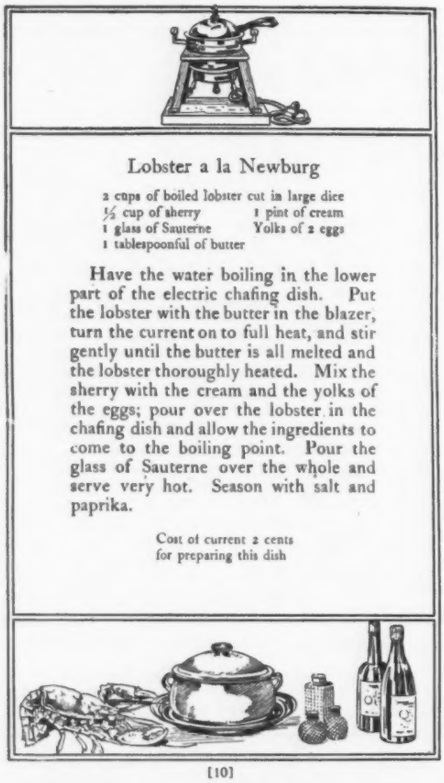
VISITORS' DAY AT THE ELECTRIC PLANT AND ITS LESSON TO THE PUBLIC.

Invitations printed in the newspapers of Nashville, Tenn., announce that every Thursday afternoon is visitors' day at the plant of the Nashville Railway & Light Company, the public being invited to inspect the station on these occasions accompanied by guides who explain the operation of the machinery.

Starting at the coal pile, the visitors are first given some idea of the quantity of coal which is required to operate the plant, care being taken to impress upon them the magnitude and actual cost of the fuel alone for a day's run. Then they are shown the great boilers and gain some understanding of the first step in power production in a steam plant. In the turbine-room the action of the steam on the blades in producing power is explained, and they are furnished with some figures regarding the cost of steam turbines, generators and electrical machinery in general. The size of these cost figures seldom fails to surprise the intelligent and interested visitor, and his respect for the organization that pervades the electric plant increases as he learns that these vast pieces of machinery must be kept running twenty-four hours a day as long as he is to have service, additional units being connected up as the load increases. After being permitted to marvel at the intricacies of the switchboard and wiring equipment, the visitor is soon ready to amend his ideas, if such have been already formed, that the operation of an electric plant is "easy." He also gets to be more considerate the next time he has a complaint against the electric company. A good and responsible class of people take advantage of the plant visits, and the company's contract men also make it a point to bring in downtown commercial consumers for an inspection along with the other parties. When first opened the visitors' days attracted crowds of several hundred on Thursday afternoon. As the novelty decreased this number has diminished until the average attendance is now about twenty-five interested persons. At the time of inaugurating visitors' day engraved announcement cards were sent broadcast, but the present newspaper display advertisements now serve to remind people of the recurrence of the Thursday afternoons. From the standpoint of public policy, these visiting days are considered of real value to the company, and Mr. J. P. W. Brown, superintendent of lighting for the Nashville system, believes that such visiting days might be instituted to advantage in many plants to bring consumers to realize better the complex and expensive equipment at the station end of their wires.

NEW YORK EDISON COOK BOOK.

The New York Edison Company has issued a very attractive book of recipes for cooking by electricity which contains many helpful suggestions as to how to get the best results from the various articles of electric heating and the best way to care for them. Each of the thirty-two pages, reduced samples of two of which are reproduced herewith, contains a simple and economical recipe which has been selected with great care. The recipes are particularly adapted to the electric chafing dish or stove which may be used on the dining-room table and connected to the lamp socket.



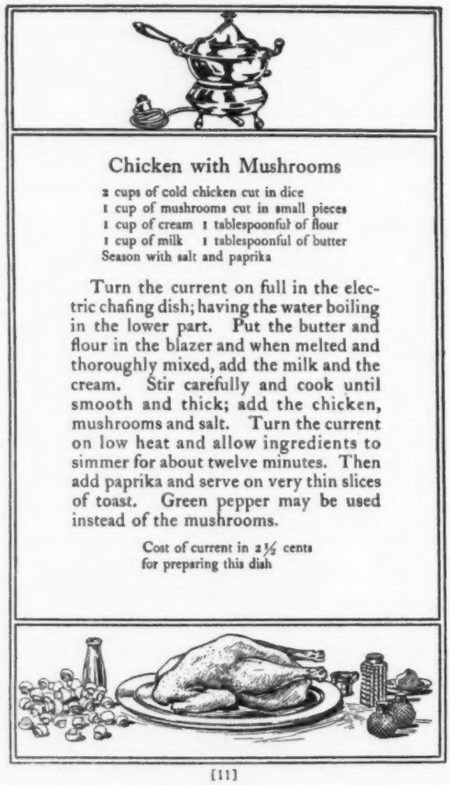
Lobster a la Newburg

2 cups of boiled lobster cut in large dice
½ cup of sherry — 1 pint of cream
1 glass of Sauterne — Yolks of 2 eggs
1 tablespoonful of butter

Have the water boiling in the lower part of the electric chafing dish. Put the lobster with the butter in the blazer, turn the current on to full heat, and stir gently until the butter is all melted and the lobster thoroughly heated. Mix the sherry with the cream and the yolks of the eggs; pour over the lobster in the chafing dish and allow the ingredients to come to the boiling point. Pour the glass of Sauterne over the whole and serve very hot. Season with salt and paprika.

Cost of current 2 cents for preparing this dish

[10]



Chicken with Mushrooms

2 cups of cold chicken cut in dice
1 cup of mushrooms cut in small pieces
1 cup of cream — 1 tablespoonful of flour
1 cup of milk — 1 tablespoonful of butter
Season with salt and paprika

Turn the current on full in the electric chafing dish; having the water boiling in the lower part. Put the butter and flour in the blazer and when melted and thoroughly mixed, add the milk and the cream. Stir carefully and cook until smooth and thick; add the chicken, mushrooms and salt. Turn the current on low heat and allow ingredients to simmer for about twelve minutes. Then add paprika and serve on very thin slices of toast. Green pepper may be used instead of the mushrooms.

Cost of current in 2½ cents for preparing this dish

[11]

Two Pages from Electric Cook Book of New York Edison Company.

more nearly correct impressions of the quality of organization required to keep the system in operation and begins to realize the immense amounts of money which must be spent before the electric company can even begin supplying him with electrical energy and all the conveniences it affords for a few cents per kw-hour.

It is with this idea of impressing its customers with the real complexities and problems of electric-plant operation that the visiting day has been instituted at Nashville. After a visit through the plant with the courteous guides who endeavor to answer all questions, even the most obdurate consumer is likely

The particular cooking device is shown at the top of the page and the ingredients and the article to be cooked are displayed at the bottom. The book is tastefully printed in two colors, the illustrations being in a pretty tint of gray and the text in dark brown.

THE COMPUTATION OF ELECTRIC-PLANT INSURANCE.

The chief influence which insurance companies can bring to bear for improvements is the fact that the better the risk from the standpoint of fire hazard the lower will be the cost of insurance. The result is that the insured, by making proper improvements in his risk, not only reduces the immediate cost of his own insurance, but also helps to keep down the total loss ratio and thus to reduce the average rate. The average rate can be controlled only by the ratio of losses to premiums. This loss ratio cannot with safety be more than 60 per cent, for if to this are added the agent's commission, amounting to an average of from 19 per cent to 20 per cent; cost of adjusters and special agents, 5 per cent; office expenses, 13 per cent, and taxes, from 2 per cent to 2.5 per cent, the total is not less than 99 per cent, which leaves a margin of profit very small, especially in view of the risk involved.

Fortunately the loss ratio usually averages a few per cent less than the above figures, said Mr. R. L. Daniel, of the Minneapolis inspection department, in an address before the Minnesota Electrical Association at its St. Paul convention March 16, from which address the facts here presented are taken. The companies thus accumulate a surplus, he said, which acts as a flywheel or, better, a storage battery, distributing the load of any disastrous year over the adjoining more profitable years. The difference between the electricity supply company and the insurance company in this respect, however, is that the insurance company never knows when to expect a "peak load."

Among the special schedules used by the insurance companies is one for electric plants starting with a base rate of 35 cents annual premium per $100 of insurance involved. This means that a standard plant would take a base rate of 35 cents, and for the various respects in which the actual plant falls below the standard additional charges are added to the base rate. In the insurance schedule the standard plant is described at some length, among the requirements being the following:

Walls must be of brick, stone, approved concrete or iron; division walls to be equal to outer walls; partitions non-combustible. Roof of metal, tile or concrete with metal trusses and supports. Floor, brick, cement or stone. Supply-room, testing and oilroom must be of fireproof construction, or cut off from the main plant. In addition to these requirements the heating, lighting and electrical equipment must conform to standard requirements for safety. Transformers must not expose switchboard, electrical machinery or any woodwork. Oil transformers must be in fireproof room. Ashes, as well as oily waste, must be kept in non-combustible receptacles and removed daily.

Basis	$0.35
Frame addition (coal shed)	.15
Frame partition (shop)	.05
Basement	.05
Roof	.10
Roof, 3 ft. above boiler	.05
Floor-wood	.15
Oil-soaked	.05
Wood ceiling	.10
Stairs to basement	.05
Shop (repairs)	.05
Two barrels of oil in engine-room	.10
Non-standard wiring in attic	.10
Wood switchboard	.25
Lightning arresters on wood	.15
Oil transformers not in fireproof room	.10
Boiler-room not cut off	.15
Stack not ventilated	.50
No waste cans	.05
No watchman	.15
No chemicals or sand pails	.10
No standpipe and hose	.15
Volunteer fire department	.15
	$3.10

Chemical extinguishers or pails of dry sand must be installed.

In estimating the rate for a plant which is not standard, charges are made for deficiencies in construction as well as for undesirable conditions connected with the operation. There are certain charges for area, stairway openings, repair work, lack of standpipe and hose, water supply and fire department that apply if the construction of the building is not standard, but where the construction is standard these same charges are waived.

The working of the schedule can best be shown by applying it to a concrete example, taking a plant such as is common in this country. The walls are of brick, 12 in. thick, with 12-in. division wall between boiler and engine-room, extending about 2 ft. above the roof. Floors are of ordinary wood construction, soaked with oil, and the wood ceiling makes a concealed space or loft in which wiring is installed to light the building. The wires are likely fastened to top of joists with cleats. The wooden roof is covered with metal or approved composition. A frame coal shed is attached to boiler-room. The schedule then works somewhat as shown in the accompanying tables.

Possible Credits:		
Cement floor	$0.15	
Would remove oil in floor	.05	
Would remove oil in stairs	.05	
Non-combustible partition	.05	
For shop	.05	
Oils in house or room cut off	.10	
Standard wiring	.10	
Standard switchboard	.25	
Lightning arresters on non-combustible supports	.15	
Oil transformers in room cut off	.10	
Fire-door on boiler-room	.15	
Ventilator for stack	.45	
	$1.65	$1.65
Rate for insurance, per $100, with above improvements		$1.45

EFFECTIVE CENTRAL-STATION PUBLICITY.

By D. H. Howard.

Numerous arguments and various methods have been and now are employed by different merchants and manufacturers in the sales promotion of an unlimited number of commodities, all of the arguments put forth carrying with them a certain amount of conviction. But in the old axiom "The proof of the pudding is in the eating" there is a valuable and most pungent suggestion embodying a certain means of positive, penetrating publicity.

This method of publicity can be adapted to the sale of almost any commodity with very satisfactory results, for it is truthfully said that "a pleased customer is the best advertisement." This is especially true with respect to the supply of electricity for lighting and industrial purposes from central stations as against the private production of electrical energy by means of the isolated-electric plant located within the building or in an adjacent building.

An isolated plant has numerous disadvantages and, except in rare instances, it has very few advantages. In the first place, considering, for example, locations in the heart of the business district, the necessary machinery, in addition to its initial expense and also the expense of operating it, occupies a very valuable space which could be put to much better and more profitable use. Then there are depreciation, the fuel problem, the smoke nuisance, labor troubles and a number of other items which must have consideration. Central-station service is available continuously day and night at the turn of a switch, whereas with the private plant it is necessary to keep the machinery moving at extra expense when overtime work is necessary.

Very few owners of isolated plants consider all the items which should be included in making up the total cost of operating their plants, and, therefore, many of these plants continue to be operated chiefly because their owners do not know what it is actually costing to maintain them. For an accurate and fair comparison of the cost of making electricity and of buying it from the central station, minus the smoke, dirt, occupancy of valuable space, etc., each of the items shown in the accompanying tabulation, which has been carefully prepared by expert engineers, should receive due consideration. In the majority of the cases central-station service will be found to have decidedly the better of the argument.

Following these arguments and to furnish "the proof of the pudding," there have recently been inserted in the newspapers of Chicago by the Commonwealth Edison Company a number of display advertisements consisting of illustrations of some of the larger and more prominent buildings in Chicago which are served exclusively with electricity from the mains of the company.

The following large buildings, among others, which formerly operated private plants have adopted Commonwealth Edison service:

	Lamps.	Horse-power.
Hotel Sherman	15,000	500
Siegel, Cooper Co.	4,500	700
The Crane Company	5,032	7296
Featherstone Foundry	.....	440
Hotel Metropole	2,800	130
Palmer House	5,000	100
Pugh Terminal Warehouse Co.	4,000	900
Weber Wagon Works	.....	400
Briggs House	1,700	60
Steger Building	3,000	250
Warren Springer	1,000	1000

This publicity has been a large factor in influencing the owners of new buildings to decide against the installation of private plants. Furthermore, the facts and figures obtained from customers who are being served from the central station furnish valuable data for owners of buildings who are operating plants in the belief that they are operating for less money than it would cost to purchase an equal amount of electrical energy from the central station.

It is the business of the electricity-supply companies to manufacture electricity in wholesale quantities in large generating stations located outside the business district and deliver this energy to customers day and night without interruption, at a decided saving in cost, to say nothing of the freedom from annoyance in obtaining the required electrical energy.

ITEMS OF COST IN OPERATING YOUR ELECTRIC PLANT

Salary of Engineers		
Salary of Firemen		
Salary of Electricians		
Fuel		
Removal of Ashes		
Water		
Oil		
Repairs to Boilers		
Repairs to Engines and Dynamos		
Lamps		
Carbons		
Tool Account		
Miscellaneous Expense and Supplies, Waste, Packing, etc.		
General Expense		
Depreciation (10% to 15%)		
Interest on Investment		
Taxes		
Insurance		
Rental Value of Space		
Damages resulting from Heat and Vibration		
Risk to employes and the public through accidents and boiler explosions		
Edison Throw-Over Service		
Total		

Fac-Simile of Central-Station Tabulation of Operating Costs of Isolated Plants.

The services of the engineers of the company are at the disposal of owners of existing plants, without cost, in making tests of their plants and furnishing estimates as to the cost of the same service from the central station.

Advertisements of this sort are in themselves a recommendation for central-station service and at the same time give the customers valuable publicity which costs them nothing.

MODERN ELECTRIC LAUNDRIES.

In New York City electric laundries are not only being installed in new residences and apartment houses, but in many old residences as well. The complete equipments now in use in a large number of the beautiful residences that adorn Fifth Avenue, Riverside Drive and Park Avenue consist of washing machines, driers, ironers and flatirons. One of the finest

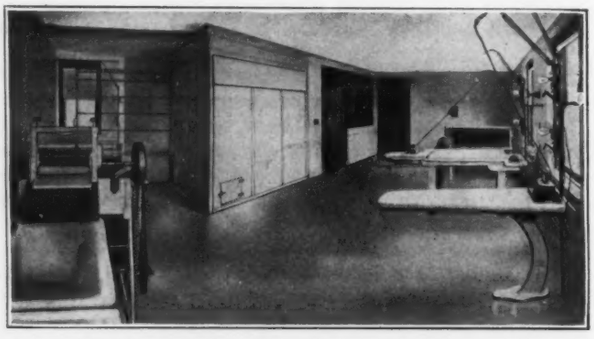


Fig. 1—Laundry in High-Class Residence.

installations in New York is that in the residence of Mr. B. N. Duke, at the southeast corner of Fifth Avenue and Eighty-ninth Street. A view of this electrical laundry is shown in Fig. 1. The washing machines are at the left, the drier with one of the sections extended is in the background, and the ironing apparatus is on the right.

Another laundry laid out very similar to that in the Duke residence is the one in the home of Mr. E. S. Harkness, at Sixty-seventh Street and Fifth Avenue. Some of the others are in the residences of Mr. J. B. Clewes, Eighty-fifth Street and Fifth Avenue; Mr. A. W. Hoyt, 934 Fifth Avenue; Mr. George J. Gould, Sixty-seventh Street and Fifth Avenue; Mr. Edwin Gould, Seventy-fifth Street and Fifth Avenue; Mr. J. B. Duke, Seventy-eighth Street and Fifth Avenue; Mr. Jonathan Bulkley, Sixty-fourth Street and Park Avenue; Mr. Percy R. Pyne, Sixty-eighth Street and Park Avenue; Mr. F. M. Warburg, Ninety-third Street and Fifth Avenue; Mrs. A. L. Douglass, Fifty-seventh Street and Park Avenue; Mr. Edward W. Sheldon, 46 Park Avenue, and Mr. W. D. Hyde, 11 East Seventieth Street. Two out-of-town residences having

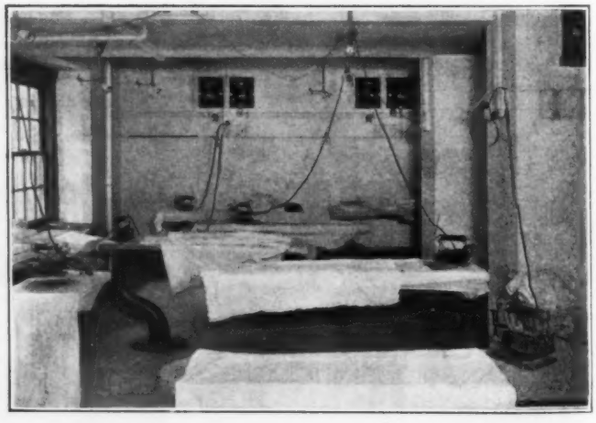


Fig. 2—Laundry in Modern Apartment House.

electric laundries are those of Miss Helen Gould, at Lyndhurst-on-the-Hudson, and Mr. E. H. Hooker, at Greenwich, Conn.

The electric laundry system has wrought a complete innovation in the family laundry work in apartment houses. In many of the large new apartment houses complete electric laundries have been installed in the basement for the individual tenants. In the mammoth new apartment house now being

erected at Eighty-first Street and Fifth Avenue, by the Century Holding Company, are a large number of complete electric laundries for the individual tenants and several other big ones with a very large capacity.

Alwin Court, at Fifty-eighth Street and Seventh Avenue, has an excellent electric laundry equipment for the use of the tenants. In addition to the other apparatus there are twenty-eight electric irons. Each tenant's iron is metered separately, as shown in the view of a portion of this installation. When the iron is not in use the maid removes the plug and with a padlock locks a steel bar across the empty socket. Lockers are provided on the opposite side of the room to hold the irons, cord and plug attachments when not in use. There is a similar installation in the large new apartment house at 44 West Seventy-seventh Street. The irons there number twenty-six. Other apartment houses which have electric laundry equipments exclusively are at 523 Park Avenue, 823 Park Avenue and 829 Park Avenue. Altogether these three apartment

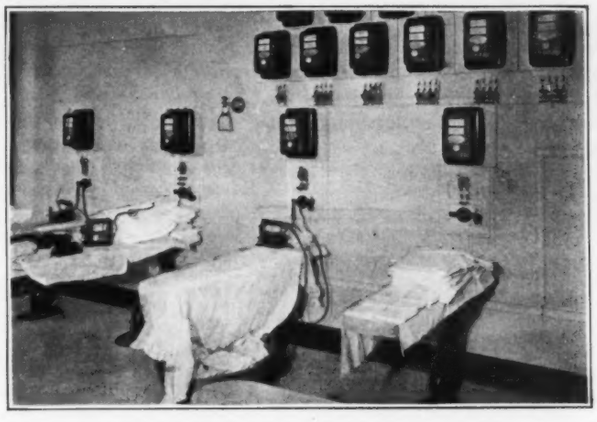


Fig. 3—Laundry in Modern Apartment House.

houses have no less than twenty-one electric washing machines.

The machinery used in most of the above installations was manufactured by the Shannon Manufacturing Company, of 124 Lexington Avenue, while the designing and laying out was done by Mr. C. P. H. Gilbert, the architect, in consultation with the heating bureau of the New York Edison Company. Another interesting installation is that of the Automobile Club of America, where six 6-kw driers are used for drying wet garments and robes. The East Side House Settlement, located at the foot of Seventy-sixth Street, also has an electric laundry, while the Deaconesses' Home, on the Cathedral grounds, 110th Street and Morningside Heights, has a laundry electrically equipped.

PART PLAYED BY ELECTRICITY IN BUILDING SKY-SCRAPERS.

There is perhaps hardly anything more spectacular in modern commerce than the business of pushing up new sky-scrapers. At the present time two prominent examples of this in New York City are the construction of the Municipal Building, opposite City Hall Park, and the 80-Maiden-Lane Building. The former is to rise to a height of twenty-seven stories, which will be surmounted by a tower of thirteen floors, making a total of forty stories in all. It is significant of the age that in neither of these undertakings is an ounce of steam being used. Electricity furnished by the New York Edison Company is the motive force throughout.

Work on the 80-Maiden-Lane Building has not progressed beyond the caisson stage, yet here also the two 150-hp electrically driven compressors—kept working twenty-four hours a day—are already showing their superiority over old-time methods. The fifty caissons to reach bed-rock must be sunk to a depth of over 60 ft., at which level the water comes in so rapidly that the sand-hogs toiling below would have very little chance of escape should the compressors stop for even the briefest moment.

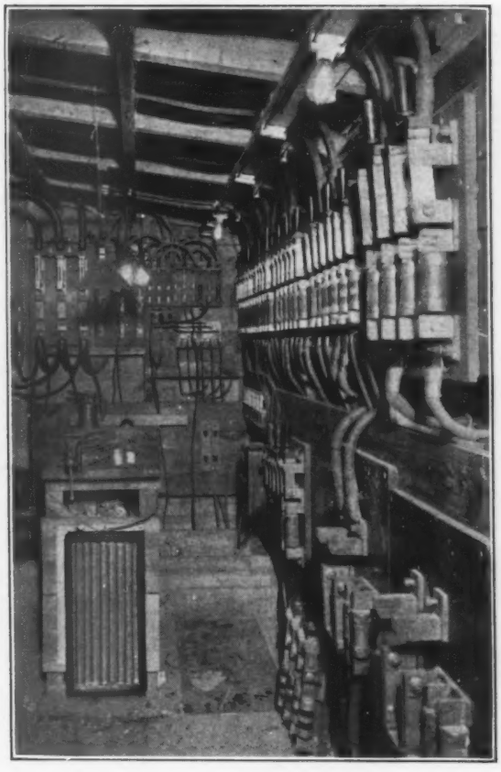


Fig. 1—Contractor's Switchboard.

On the Municipal Building even the hoisting signals are no longer given by hand, for an electric gong in the operator's cage gives an absolutely sure connection, in all weathers, with

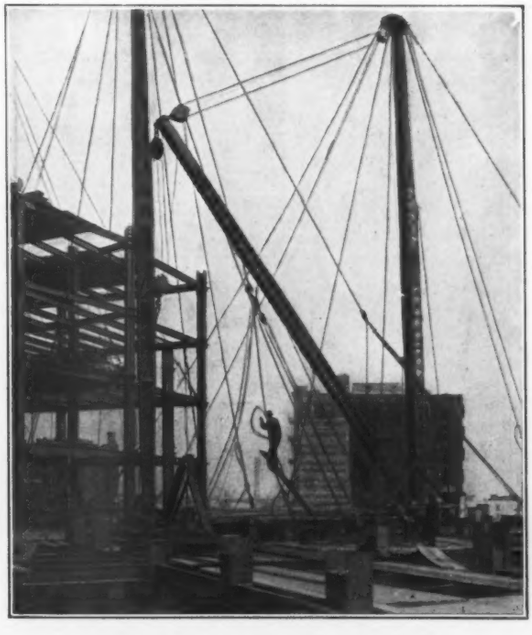


Fig. 2.—Electric Hoist on Municipal Building.

the street. The motor equipment on this building—averaging an energy consumption of 36,000 kw-hours a month—consists of two 44-hp passenger elevators, eight 80-hp and five 40-hp

steel hoists, besides two compressors of 50 and 30 hp respectively, which operate the twenty-one riveters scattered over the structure, twelve 40-hp hod-hoists, and four 15-hp concrete mixers, with three water pumps, two of which are rated at 7½ hp and the other at 10 hp.

An interesting feature, during the winter months, was the

Fig. 3.—Electric Crane on Maiden Lane Building.

heating of the different offices about the building by a battery of twenty electric heaters. In this building are two giant girders which were brought across the city, each behind a team of thirty-six horses. These were swung up into their final resting place in the Municipal Building by electric power.

Fig. 4—Electric Heater Used in Contractor's Offices.

Figuring the comparative cost of steam versus electricity in this small item of lifting alone, steam would have meant an expenditure, roughly speaking, of $18, while electricity cost $11! A trivial saving, perhaps, in an enterprise involving millions, but that same $7 is but an indication of the continued economy electricity is effecting in building construction.

Wiring and Illumination

COMMERCIAL LAMPS IN CHICAGO.

The largest number of arc lamps connected to the mains of the Commonwealth Edison Company of Chicago was 17,500 in the year 1907. The commercial use of arc lamps is decreasing in that city, as elsewhere, and the number now operated by the Commonwealth company is about 11,600. The remarkable increase in the use of tungsten clusters has had much to do with the decrease in the number of arc lamps in service. The number of tungsten clusters in use in Chicago is now about 16,000, and the growth of this service has been phenomenal since it was established, something like two years ago. These facts were contained in a recent paper by Mr. W. L. Abbott, chief operating engineer of the company, who gave a curve showing that, although both direct-current arc lamps and alternating-current arc lamps are decreasing in number, the rate of decrease is more noticeable in the case of the direct-current lamps than in that of the alternating-current lamps. At present there are about 7000 direct-current inclosed-arc lamps supplied with energy by the central-station company in Chicago, about 3600 alternating-current arc lamps and about 1000 direct-current series-arc lamps.

"WHITE-WAY" LIGHTING USING SIDEWALK "GALLERY" SUPPORTS IN SOUTHERN CITY.

The erection of "white ways" and ornamental curb lighting in most Southern cities is hampered by the presence of the characteristic "galleries" or roofed sidewalks which protect pedestrians from sun and rain. These galleries are installed very generally throughout the South and Southwest, and any attempt at decorative lighting must consider and avoid them, for they are usually of very permanent construction and of the nature of fixed institutions along the street.

The accompanying illustration shows a piece of ornamental curb lighting at Mobile, Ala., in which use was made of the existing gallery posts for support. Special bracket castings were made to harmonize with the pillars. The four-bracket castings fit together to form the square inclosing the post, which is sealed top and bottom by a split plate clamped around the post. The wires are brought into the fixtures from conduit run

Adaptation of Gallery Supports for Ornamental Lighting in Mobile, Ala.

along under the gutter of the gallery. Each bracket arm carries a 100-watt tungsten lamp inclosed in a 14-in. frosted globe. This installation was arranged by the Mobile Electric Company, which has interested itself in making use of similar bracket arms for converting all the gallery supports along the street into lighting standards, realizing Mobile's proposed "white way."

ORNAMENTAL STREET LIGHTING WITH 250-WATT TUNGSTENS.

Mylan Street, Shreveport, La., is lighted by 250-watt tungsten lamps, suspended from crook hangers, on poles erected at 55-ft intervals along the curb. Each lamp is inclosed in a

Fig. 1.—250-Watt Tungsten Lamps on Bishops' Crooks at Shreveport, La.

14-in. Alba ball, and by means of the crook is projected three feet over the curb-line. Mr. J. E. Cowles, superintendent of the lighting department of the Shreveport Gas and Electric Company, reports that five blocks of this kind of lighting have

Fig. 2—Exterior Illumination of Theater at Shreveport, La.

now been contracted for. The installation is made on a three-year contract, adjoining merchants paying 10 cents per linear foot, according to their respective fronts. This ornamental lighting installation is operated nightly until 10:30 o'clock. All costs of installation, maintenance and renewals are met by the company out of the monthly revenue derived from the adjoining merchants.

VILLAGE STREET LIGHTING.

A successful new system of street lighting installed in the village of Falconer, N. Y., consists of 159 series-tungsten lamps of 25-cp each, mounted singly, and of four clusters of four 60-watt tungsten lamps. These lamps supplant 181 16-cp carbon incandescent lamps, with more satisfactory results. Each of the 25-cp lamps takes 31 watts and both these lamps and the 60-watt lamps take 5.5 amp. The village is abundantly supplied with shade trees, and in order to place the individual lamps in such a manner as to secure the best illumination some of them are mounted over the street and some over the sidewalk, as circumstances dictated.

Electrical energy is purchased from the Jamestown Lighting & Power Company by Mr. Fred Sprague, owner of the Falconer electric light plant, which was recently destroyed by fire. Mr. Sprague charges the village $13 a year for each of the individual lamps, including maintenance. In addition, he agrees to supply all lighting needed for the village hall, to the amount of $4 a month, free of charge. When the meter reading shows that the amount of electrical energy consumed in the village hall is more than $4 worth in any month the excess is paid for at the rate of 5 cents a kw-hour.

The lighting equipment includes an 8-kw Westinghouse regulating transformer with control panel. An automatic time switch is used so that the street lamps are cut in and out at a stated time. This renders the street-lighting outfit practically automatic in its operation. Although the regulator is loaded nearly to its rated output, no particular trouble has been experienced in throwing the load directly upon the regulator, as the movement of the coils when so loaded is so short that the momentary increase of current flow does not materially affect the tungsten lamps. The village pays about $350 a year more for the new tungsten lighting than it did for a greater number of carbon lamps under the old plan. As the lamp units are larger and the light more satisfactory, the change is considered a desirable one not only by Mr. Sprague but by the village authorities as well.

RECENT DEVELOPMENTS IN TRAIN LIGHTING.

In the course of a paper on "Recent Developments in Train and Car Lighting" read before the Chicago Section of the Illuminating Engineering Society on April 20 Mr. C. R. Gilman, of Milwaukee, chief electrician of the Chicago, Milwaukee & St. Paul Railway Company, laid stress on the fact that the use of shades over bare lamps is the greatest recent general improvement in electric train lighting. Next to this in importance comes the intelligent use of reflectors, and this involves often a marked reduction in the number of lamps necessary to give a required illumination. Indeed, the decrease in the number of lamps that may sometimes be made by the use of reflectors is amazing, and Mr. Gilman cited an instance in the case of one particular car where reflectors enabled a reduction in consumption of from 8.45 watts to 2.16 watts per square foot of floor area. In this one car the saving in the cost of electricity was over $200 a year.

In the West nearly all of the railroads use the head-end system of train lighting, installing a generating set in the baggage car next the engine and supplementing this source of energy by storage batteries floating on the main circuit in parallel with the generator. The use of tungsten lamps has been particularly advantageous in train lighting and perhaps the potential of 64 volts for this service may now be considered standard.

Mr. Gilman devoted some attention to describing the lighting and fixtures of the "Pioneer Limited," a seventeen-car train running between Chicago and Minneapolis on his railroad. On this train there are 872 12-cp tantalum and tungsten lamps. One advantage of the use of tungsten lamps compared with carbon lamps which is particularly desirable in train lighting is the fact that a substantial reduction may be made in the weight of generating equipment and batteries.

Not much attention has been paid in the past by train-lighting engineers to the intelligent reduction in the number of lamps in a car by the use of reflectors, but this is a subject which will have careful consideration given to it in the future. Referring to the "Pioneer Limited," the speaker described a variety of fixtures used on the train in sleeping-cars, dining-cars, day coaches and mail-cars. In the case of the mail-cars he remarked that a change had been made from trough reflectors to individual reflectors and the latter method may now be considered standard.

In the discussion there was something said about the measurement of intensity of illumination, whether on a horizontal plane 33 in. from the floor or at an angle such as will be formed by a paper or magazine held by a passenger in reading. It seemed to be the general opinion that for all practical purposes the horizontal-plane measurement is sufficient. The Association of Railway Electrical Engineers is endeavoring to standardize the number of ft.-candles of illumination required for certain types of cars.

One particular difficulty in train lighting is the trouble in keeping the lamps, shades and reflectors clean. These parts of the lighting system should really be cleaned after every long trip, but it is difficult to accomplish this. Fixtures for car lighting should be made as simple as possible to enable the cleaning to be done readily. Frosted bulbs are more difficult to clean than clear-glass bulbs, and that is the reason why the latter are often preferred by train-lighting engineers.

Compressed gas is not being forced out by electric lighting. This method of lighting is efficient and economical and gives good illumination. Undoubtedly, however, electric lighting is preferred by the traveling public.

In the head-end systems the generator used has a rating usually of 15 kw or 20 kw. Mr. Gilman said that the first cost of the head-end equipment is much less than that of the car-axle system, although the latter has the advantage, of course, of making each car an independent unit. In a seventeen-car train, for instance, the total cost of the head-end lighting may be estimated as $4,000, whereas it would cost nearly $1,500 to equip each car separately for car-axle lighting. Another point brought out was that there is a tendency to use lighter colored woodwork and decorations in car interiors in order to make the illumination more effective.

Mr. Arthur J. Sweet pointed out that there seemed to be a preponderance of axle-lighting systems on the Eastern roads. He referred to the psychology of the problem. Passengers may think a car dim when it is really lighted sufficiently. The traveling public as well as people generally should be educated to the fact that glare does not mean useful light. Among those who took part in the discussion were Mr. C. W. Naylor, of Chicago; Mr. Francis A. Vaughn, of Milwaukee; Mr. George C. Keech, of Chicago, and Prof. A. M. Wilson, of the State University of Kentucky, Lexington, Ky.

SIMPLE METHOD FOR CALCULATING ILLUMINATION.

By J. R. Cravath.

Probably the great majority of the ordinary commercial calculations of illumination for large rooms during the past few years have been carried on by means of simple constants based on the results of tests in rooms of the same character as those under consideration. During the first few years that illuminating engineering was actively practised the methods used were rather laborious and formidable. Later as the number of available results of actual tests increased it was possible to obtain certain constants for ordinary commercial work in calculating illumination which on the whole were more accurate than the laborious theoretical methods previously applied, because the theoretical methods necessarily involved a number of assumptions which were only approximately correct.

With the aid of figures obtained from practical experience it was possible to predict with tolerable accuracy in advance that for each watt expended per square foot in lighting a room under certain conditions it was possible to obtain an average illumination of a certain number of ft.-candles, dependent on the equipment used and the character of the room. This factor, known among illuminating engineers as lumens per watt, or its reciprocal, watts per lumen, affords a short cut in illumination calculations which has doubtless been made use of in more calculations of illumination the past three years than any other method. The first "watts per lumen" table of this kind appeared in the *Electrical World* for July 11, 1908, in an article by the present writer and Mr. V. R. Lansingh, and the method soon came into general use.

The lumens per watt—that is, the average ft.-candles obtained for each watt per square foot—indicate the over-all "measured" efficiency of an electric lighting installation as far as it is possible to measure such efficiency with a photometer. The term "measured efficiency" should perhaps be used instead of "efficiency," for the real efficiency, or rather efficacy, of any lighting installation is dependent on physiological effect on the eye, which cannot be measured with a photometer. The measured efficiency is the ratio of the light output of the lamps to the average illumination as measured on the working plane selected. Constants based on lumens per watt or watts per lumen take into account two things: first, the efficiency of the lamp itself as a light producer, and, second, the efficiency with which the light produced is utilized in any given installation. It has heretofore been feasible to adopt a single figure covering the over-all efficiency for certain typical rooms and lamp equipments because the efficiencies of lamps of various types have been kept about the same from year to year.

Recently, however, as far as tungsten lamps are concerned, a situation has arisen which seriously raises the question whether it is not best to determine first the efficiency of an installation in utilizing the light produced independently of the efficiency of the lamps themselves. The reason for this is that most American manufacturers of tungsten lamps have adopted the policy of making certain standard wattages and varying the lamp efficiency from time to time as changes in lamp manufacture make it advisable in the opinion of the manufacturers. The general scheme adopted up to date is to maintain the wattage and the hours' life constant for any given size of lamp, and to make the changes, if any, in the efficiency of the lamp. Along with this they have adopted the commendable practice of tabulating the lumens obtainable from the various sizes of lamps when operated at various voltages.

Now, it is evident that if tungsten lamps are to be changed in efficiency at frequent intervals in the future, and that if, as seems likely, the majority of illumination calculations in the immediate future will be in connection with tungsten lamps, the illuminating engineer must have a great number of constants to deal with if he attempts to have at hand constants to apply to the large number of possible lamp efficiencies and lighting installations with which he must commonly deal.

To put the matter in another way, the measured efficiency of utilizing light with a certain set of fixed conditions does not change, but the efficiencies of lamps are being shifted by the manufacturers, or by the particular voltage conditions under which they may be used. For this reason it may very likely prove desirable to use a somewhat different method in the calculation of illumination from that employing watts-per-lumen or lumens-per-watt constants. This method should preferably have one set of constants to apply to the measured efficiency of utilization of the light produced.

A table of lumens effective per lumens generated will show in per cent what the measured efficiency of any lighting installation is likely to be under certain conditions as far as the utilization of the light produced alone is considered. Then by means of tables giving the actual lumens produced by various lamps under the voltage conditions in question the number of lamps of a given size required can easily be obtained. Then as lamp efficiencies change the illuminating engineer need only change his lamp tables, while his tables on measured efficiency of utilization remain the same. That is, the lumens effective per lumens generated would remain the same.

The value of the lumens effective per lumens generated in ordinary commercial lighting systems will vary all the way from about 65 per cent down to 10 per cent and lower, depending on the color of the ceiling, walls and floor of the room, the lamp equipment in the shape of reflectors and diffusing glassware, the amount of dirt on lamps and equipment and other factors.

The calculation of illumination by means of constants of this kind is simple, although requiring one more step than the watts-per-lumen or lumens-per-watt constants heretofore used. The method of procedure is as follows: After deciding upon the average ft.-candles illumination on the working plane which in the judgment of the designer is necessary for the installation under consideration, apply the following rule: Multiply the average ft.-candles by the square feet, and divide this product by the efficiency constant for the given conditions. The result

will be the total number of lumens which the lamp must generate. Tungsten lamps are now rated in the manufacturers' table according to the lumens they produce, and the same will doubtless soon be true of other lamps. The engineer then selects lamps of a sufficient number and size to generate the lumens necessary for the installation. The lumens generated by any lamp can be determined by multiplying the mean spherical candle-power by 12.57.

The derivation of the foregoing rule is very simple. Multiplying the average ft.-candles by the square feet of area to be illuminated in reality gives the actual lumens required on the working plane, because one definition of a lumen is the flux of light required to produce an average illumination of 1 ft.-candle over an area of 1 sq. ft. Having ascertained the total lumens required on the working plane it is simply a matter of dividing by the efficiency of utilization in per cent to give the lumens required at the lamps before any of the losses occur.

RECENT TELEPHONE PATENTS.

AUXILIARY DEVICES.

Three patents have been granted to Mr. E. L. Buxbaum, of Chicago, which describe devices for call registering. A counter box is attached to the telephone in such a manner that a locking bar, a part of the device, engages the hook lever. Three counters are provided. One actuates the out-message counter, one the in-message counter and one records the messages which fail of completion. The lock bar is released by counting a message. An auxiliary lock is provided to prevent any counting at all if the owner so desires. In a more complex form two counters are used. One is at the station and one at the central office. Both operate simultaneously either under control of a push button at the station or a key at the exchange.

Mr. J. B. O'Hara, of Philadelphia, has obtained a patent for a disinfecting device for transmitters. A cup-shaped holder is swung across the front of the mouthpiece. This contains absorbent material wet with disinfecting liquid. A screen retains the absorbent. This screen is held by a central pin which passes through the cup and terminates in a finger clip.

In some transmitters a stretched diaphragm is used to increase the efficiency. It is found that if the diaphragm gets hot it expands and loses tension. To overcome this Messrs. C. E. Enger and J. G. Holmstrom, of Sweden, have arranged a cooling device which consists of a tube coiled spirally and placed near the diaphragm. Liquid is forced through the tube and conducts the heat away.

EXCHANGE CIRCUITS.

With the usual supervisory signal system in common battery system one lamp suffices for each cord, this lamp indicating merely the position of the hook switch of the connected station. Mr. W. G. Blauvelt, of New York City, has thought it of advantage for the operator to be able to distinguish between a non-answered call and a call completed. He therefore arranges two supervisory lamps for the calling cord, which are controlled not only by the relays of the cord circuit but also by a "stage" switch. During the first or calling stage the switch maintains one lamp in operative relation to the circuit and upon response of the called party the stage switch advances so that the second or disconnect lamp is alone associated with the circuits. This patent is assigned to the American Telephone & Telegraph Company.

Call distributing systems have been subject to the attention of Mr. F. G. Agrell, of Stockholm, Sweden. He has found that with such a system, wherein the answering operator has no permanent association with the subscribers answered, if a call is made for a station upon the calling line a continuous busy report is given. This arises from the fact that the answering operator does not normally know the number of the calling line. In order to overcome this difficulty he introduces a "reverting" signal which glows if the line tested by a calling cord be the same as that associated with the answering cord.

LETTERS TO THE EDITOR.

Transformer-Principle Electric-Heating Apparatus.

To the Editor of Electrical World:

SIR:—Attention should be called to the fact that the transformer principle for heating apparatus, described on page 875 of your issue for April 6, has been known for a long time, having been proposed by me fifteen years ago. It has been described in the *Zeitschrift für Elektrotechnik*, published in Vienna, Austria.

Zwickau, Saxony, Germany. GUSTAV W. MEYER.

The Tungsten vs. Flaming-Arc Lamp.

To the Editor of Electrical World:

SIR:—In reading Mr. Magdsick's letter in your issue of May 11 I gather the impression that the main object of the writer was to defend the tungsten lamp cluster against the flaming-arc lamp for industrial lighting. I heartily agree with Mr. Magdsick that interest on first investment, depreciation, repairs, etc., should be given due consideration, but at the same time I cannot agree with the prevalent tendency to prescribe tungsten-filament lamps as a universal patent medicine for every case of illumination.

From a casual reading of the letter one cannot help but gain the impression that a flaming-arc lamp would be of no commercial value as an illuminant except when the cost of the energy reaches 10 cents per kw-hour, and that for industrial illumination the 1000-watt tungsten lamp cluster is the only one worth consideration. Mr. Magdsick does not, however, mention that at a 4-cent rate the flaming arc would show a saving of 7½ per cent over the tungsten cluster even if all his figures are accepted as a fair basis for the comparative calculation.

Considering the general lack of provision for the easy access to the tungsten clusters for cleaning and renewals, the figure given for cleaning seems somewhat out of proportion. In many cases dust and smoke would necessitate a far more frequent cleaning than that assumed if a decided impairment of illuminating intensity is to be avoided. Furthermore, it is very questionable whether 1700 hours' life of a tungsten lamp is a fair assumption when used in an industrial establishment where the lamps are frequently subject to considerable vibrations and when accidental breakage has to be included. The highest claim I had previously encountered was 1400 hours, and I should judge that 1200 hours would be a more reasonably conservative basis.

Mr. Magdsick maintains that in actual practice it has been found that a higher illumination can be obtained from a 1000-watt cluster than from a 10-amp arc with a standard globe equipment. If reference is made to a flaming arc, I have reason to doubt that his assertion can be substantiated provided the test is carried out on a perfectly fair basis, that is, under identical conditions and on the basis of proper attention to the flaming-arc lamps (as provided for in the estimate) and after the tungsten lamps have been used approximately one-half their assumed life and these lamps have been taken from an average consignment. But, even granted that the comparison between a 17-hour, 10-amp flaming-arc lamp and a 1000-watt tungsten lamp cluster should balance until the rate reaches between 3 cents and 4 cents per kw-hour, would it not be pertinent to make a comparison between the 1000-watt cluster and the long-life flaming arc as well?

Say that we choose a 10-amp flaming arc with a life of 150 hours instead of 17 hours per trim. The cost of maintenance per 1000 hours then is as follows:

Globes	$1.50
Electrodes, 8 at .25	2.00
Trimming, etc., 8 at .075	.60
Repairs	1.00
Maintenance	$5.10

in which Mr. Magdsick's figures are used as far as globes and repairs are concerned, together with the liberal assumption of eight trims to 1000 hours. Compiling the total cost of 4000 hours at a 2-cent rate for energy, we get

Fixed charges	$11.00
Maintenance, 4x5.10	20.40
Energy	44.00
Total	$75.40

which compared with $103.63 shows a saving of 27 per cent in favor of the flaming-arc lamp. At a 3-cent rate, which is not at all uncommon, the saving would be 31 per cent.

I am ready to admit that the flaming-arc lamp is useful only under conditions where a highly concentrated unit can be utilized to advantage; but wherever these conditions exist the up-to-date flaming lamp is well worth consideration and recognition.

The field of the tungsten-filament lamp is such a great one that it seems a waste of time and energy on the part of tungsten-lamp advocates to preach against the flaming-arc lamp instead of giving it due credit.

J. Gustaf V. Lang.

Davenport, Ia.

Digest of Current Electrical Literature

ABSTRACTS OF THE IMPORTANT ARTICLES APPEARING IN THE ELECTRICAL PERIODICAL PRESS OF THE WORLD

Generators, Motors and Transformers.

Interpole Machines.—F. Punga.—Interpole machines have in general a smaller voltage drop than direct-current machines without interpoles. This is primarily due to the absence of counter amp-turns. In cases where a certain voltage drop is required for operation in parallel the remedy is to use rather broad pole shoes for the interpoles, together with a displacement of the brushes from the geometrical neutral zone. Even a very small displacement of the brushes has a considerable effect on the voltage drop. In case there is found a discrepancy between the calculated voltage drop and the voltage drop found by experiment, one is inclined to attribute this to a displacement of the brushes from their geometrical neutral zone and to overlook another factor which could influence the voltage drop. This factor is the influence of the commutation pole winding on the main poles. In Fig. 1 and Fig. 2 a_1a_2 . . . are the commutation poles and b_1b_2 . . . are the main poles. Only the interpole winding is shown. The method of connecting the

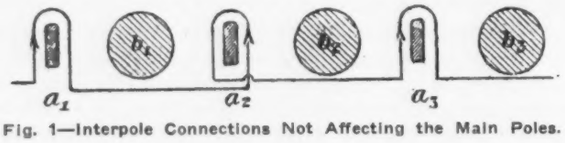


Fig. 1—Interpole Connections Not Affecting the Main Poles.

commutating pole winding is different in the two figures. In Fig. 1 the connections are on the same side of the main poles. In Fig. 2 they are alternately on different sides. Both methods are used in practice. That of Fig. 2 has the advantage of a better utilization of material. It is seen, however, by a comparison of Fig. 1 and Fig. 2 that the connecting wires of Fig. 2 form half a turn with respect to the main poles, while in Fig. 1 there is no effect on the main poles. If i is the current in the auxiliary pole winding (in general equal to the total

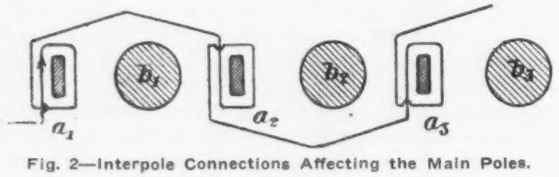


Fig. 2—Interpole Connections Affecting the Main Poles.

current of the machine) the auxiliary pole winding produces $i/2$ amp-turns with respect to the main poles and this number may be positive or negative according to the method of connections. Two otherwise identical machines which are connected according to Fig. 2 and in which the end connections are on different sides may therefore show a difference of i amp-turns in their excitation and with low-voltage machines this may be a quite considerable difference. For instance, with a 240-volt, 240-kw machine the effect may be ± 500 amp-turns per pole, hence the difference between the two machines may be 100 amp-turns. This may be sufficient to endanger the operation in parallel. In the same way as the auxiliary pole winding can have an effect on the main poles there may also be an effect of the compound winding on the auxiliary poles if the connections are made alternately on different sides. As in the preceding case, there is then an increase or decrease of the auxiliary pole amp-turns, according to the direction of rotation and the method of connections. Reversible compound motors (or series motors) should, therefore, always have the connections of the commutation windings on the same side to make sure that commutation shall be perfect. The author finally gives the following rules, which are, however, to be followed only when the amp-turns in the main pole winding or compound winding form a considerable percentage of the auxiliary pole amp-turns or the main pole amp-turns respectively. First, for reversible interpole motors the connections between adjoining auxiliary pole windings and also between adjoining compound windings should always be made on the same side. Second, for machines which rotate always in the same direction connection of adjoining windings alternately on different sides is permissible, but the mutual effect of compound and auxiliary pole windings must be taken into consideration. Third, in special cases (low-voltage motors or motors of very large capacity) the compound winding may be omitted and yet a satisfactory compounding effect may be obtained by the auxiliary pole-winding arrangement of Fig. 2.—*Elek. u. Masch.* (Vienna), April 9.

Self-Exciting Three-Phase Commutator Generator.—R. Rüdenberg.—A mathematical discussion of the behavior of a three-phase commutator machine when running unloaded as a generator. It is shown that the machine is self-exciting and can be made to generate three-phase currents of any frequency. The self-excitation as well as the frequency of the three-phase currents depends only on the value and phase relation of the ratio of transformation between rotor and stator and they can be adjusted by changing this ratio of transformation. The circular diagrams representing the phenomena are given.—*Elek. Zeit.*, April 20 and 27.

Surging of Three-Phase Generators.—F. Punga.—The author refers to the mathematical theory of the surging of three-phase generators and gives experimental data to show that the well-known formula of Rosenberg for the critical moment of inertia which represents the limit of operation without surging may lead in some cases to considerable errors. The author describes another method of calculating the critical momentum which promises to be more exact.—*Elek. Zeit.*, April 20.

Lamps and Lighting.

Mercury-Arc Lamp with Tungsten Electrode.—E. Urbain, C. Scal and A. Feige.—A French Academy paper on a new mercury-arc lamp in which the arc is formed between an anode of tungsten and a cathode of mercury at a distance of 5 mm (200 mils.) from each other. In the well-known mercury-vapor lamp with an anode of iron there is a considerable distance between the anode and cathode and the tube radiates light all along its whole length, the mercury vapor being luminescent

and the anode remaining cold. If an iron anode is approached to the mercury to a distance of a few millimeters a real arc is produced, but the iron is overheated and fuses. The use of a tungsten electrode permits one to form an arc in which the mercury serves only for lighting the arc. This electrode is brought to incandescence under the best conditions which can actually be obtained and the transport of the metal which forms the electrode to the negative pole does not seem to be large, which is of importance for long life. The luminous efficiency of the lamp is particularly high, the specific consumption being 0.45 watt per candle. The lamp operates at a potential difference of 12 volts, but by increasing the pressure of an inert gas in the lamp it is possible to increase the emf. An examination of the spectrum of this new lamp shows that it consists of a continuous and highly luminous spectrum upon which are superposed the rays of mercury. The very intense blue portion in the continuous spectrum is reinforced by the mercury rays, which makes the color of the light very similar to sunlight. This is, therefore, a source of very white light and by employing a quartz tube an intense and very economical source of ultraviolet rays can be obtained.—*L'Industrie Elec.*, March 10.

Candle-Power Measurements.—The final report of the committee on illumination of the German Association (Verband) of Electrical Engineers on revision of the rules for the measurement of mean horizontal candle-power. These rules will be voted on at the coming annual meeting. When the term candle-power is used without further qualification the mean horizontal candle-power is meant if the lamp is used in a vertical position. The mean horizontal candle-power is determined by the method of rotating the lamp. The speed of rotation is to be adjusted so that there is no disturbing flicker in the photometer and no obnoxious distortion of the filaments. If the latter cannot be avoided use is to be made of another method in which the lamp is not rotated; for instance, Brodhun's method of rotating mirrors or the method of making photometric measurements in a large number of directions. Incandescent lamps calibrated by the Reichsanstalt are used as standard lamps. The direction in which the candle-power has been determined must be marked on the lamps and the optical axis of the photometer must be coincident with this direction during the measurement. Instead of standard lamps other incandescent lamps free from errors can be used, especially for measurements lasting a long time. Their candle-power must be determined by direct comparison with a standard lamp. Before being used they should have been operated for at least fifty hours and should have as nearly as possible the same color of light as the lamp to be photometered. The illumination of the photometer screen should not be much above 30 lux. The length of the photometer bench is to be selected correspondingly. For candle-powers up to about 100 hefners a length of 2.5 m and a candle-power of 10 hefners to 25 hefners of the standard lamp are sufficient. The voltage measurement must always be made at the terminals of the incandescent lamp. Two methods of making the measurements are described in detail.—*Elek. Zeit.*, April 20.

Photography and Photometry.—J. S. DOW AND V. H. MACKINNEY.—A paper read before the Royal Photographic Society in London. The authors point out that the connection between photometry and photography is closer than might be supposed, and that each art can come to the assistance of the other. They suggested the actual measurements of the surface brightness of the various objects to be brought out in the field of view of a photograph as a means of determining the correct exposure. They showed a series of photographs in which this principle had been applied, the method being to measure the brightness of the chief objects in the field with the lumeter illumination photometer. This instrument enables the brightness of distant objects to be readily determined, and the authors have used it for studying even such objects as buildings, trees, etc., the apparent brightness of which is largely dependent on the state of the intervening atmosphere. The range of surface brightness of objects which are met with in ordinary photography is enormous. Thus, a white surface illuminated by direct bright sunlight may approach 5000 ft.-candles, but on a dull day may be 1 ft.-candle and less, while dark parts of interiors may yield values of the order of hundredths of a ft.-candle. On the other hand, the brightness of actual illuminants is enormous, the electric arc having a brightness equivalent to some millions of ft.-candles. A branch of work in which measurements of surface brightness appear to be especially serviceable is the photography of artificially lighted interiors. One question to be borne in mind was, of course, the actinic value of different illuminants. It was suggested that, although a measure of surface brightness will yield valuable comparative results for the same illuminant, the difference in actinic value must be allowed for when examining interiors lighted by different means.—Lond. *Electrician*, April 21.

Generation, Transmission and Distribution.

Use of Carbon Dioxide Recorder.—W. N. Y. KING.—An illustrated article in which the author describes his experience with a Simmance-Abady carbon dioxide recorder during the last two years in connection with a battery of large water-tube boilers mechanically stoked, with chain grates. The author first describes in detail the method of working the instrument and then gives the results of his experience concerning what could be done with the carbon dioxide recorder. One of the most important facts which have been shown by the carbon dioxide records is that the limit of the carbon dioxide obtainable under satisfactory working conditions is set by the highest temperature the grates will bear without rapid deterioration. In the author's plant with the type of stoker employed the carbon dioxide recorded for a whole day's run of eighteen or nineteen hours will vary not more than 2 per cent between the maximum and minimum during the firing hours—that is, from 11 per cent to 9 per cent. When fires are banked and fans shut down the carbon dioxide will drop off gradually to 2 per cent or 3 per cent only. If, in case of necessity, hand-firing is resorted to, the variations shown by the charts amount to 5 per cent or 6 per cent two or three times during each hour—that is, from 7 per cent to 12 per cent or 13 per cent carbon dioxide. From these observations it is evident that the engineer-in-charge has a very valuable means of control over the working of the fires, as it shows very clearly how the regulation of the fuel feed and draught is conducted, and the fireman, conscious that the record is being made, takes a greater interest in his work, with the result that considerable economy is obtained. No difficulty is experienced in getting a uniform number of records per hour, day after day, as the working cycle remains unaltered so long as the water supply is not interfered with; a very suitable chart is obtained by working at a rate of from twelve to fifteen strokes per hour.—Lond. *Elec. Review*, April 14.

Testing of Turbo-Generator.—M. HERRMANN.—Details of a test of a Bergmann steam turbine running at 1500 r.p.m. and coupled with a 2500-kw, 3300-volt, 50-cycle three-phase generator.—*Elek. Zeit.*, April 20.

Installations, Systems and Appliances.

Flat Rates and Renting of Lamps for Small Installations.—An article pointing out that in order to make electric light popular with the small consumer a flat rate and easy terms in making the istallation are most important. The rates printed herewith are charged by electricity works in Bochum in Westphalia, Germany, based on metallic-filament lamps consuming not over 1.1 watts per candle.

Rated Normal Candles per Lamp.	Rate in Dwelling Houses per Lamp per Month in Cents.	Rate in Offices per Lamp per Month in Cents.	Rate in Restaurants and Bakeries per Lamp per Month in Cents.
16	12	15	18.8
25	18.8	22.5	28.8
32	25	30	37.5
50	37.5	45	56.25
100	75	90	112.5
200	150	180	225

These amounts are to be paid monthly in advance. The contract lasts for at least a year. The station carries out the installation at its own expense if the consumer agrees to pay an extra charge of 4 cents per month per lamp (with a minimum charge of 10 cents per month) in advance for at least a year or as long as the installation is in use. If this charge has been paid for five years (and it is immaterial who has been paid for it) the installation becomes the property of the consumer or the owner of the house. The installation is maintained by the central station, but the consumer has to pay for maintenance. Lamps are rented under similar conditions. It is pointed out that such easy terms should be allowed wherever there is competition with gas.—*Elek. Zeit.*, April 27.

Standardization Rules.—A set of proposed standardization rules for construction and testing of high-tension apparatus, including oil switches, insulators, lightning arresters, series transformers, etc. There are three sets of rules; first, general regulations; second, special regulations for oil switches, and, third, examples are given for three-phase plants. These rules have been revised by a committee and will be voted on at the next annual meeting of the German Association (Verband) of Electrical Engineers. They are to go in force on Jan. 1, 1912. —*Elek. Zeit.*, April 13.

Electric Heating.—G. B. Barham.—An article on some "uncommon applications of electric heating" dealing with the use of electric heating in connection with the printing press, in laundries, in paper making, textile and other industries, and in bakeries.—Lond. *Elec. Review*, April 14.

Paris Flood.—An account of the Paris floods of 1910 and their effects on electrical apparatus. Measures are suggested for the protection of stations against the invasion of water, and methods of drying and putting into running order fixed machinery and portable machinery are described.—Lond. *Elec. Review*, April 14.

Electrophysics and Magnetism.

Discharge from an Electrified Point.—A. M. Tyndall.—Some experiments chiefly on the pressure of the electric wind and the field in the neighborhood of a discharging point led Prof. A. P. Chattock and the author to adopt certain theories as to the nature of point discharge which at the time were capable of explaining most of the results obtained. The author has since extended the experiments, and has obtained results which are to a certain extent at variance with these theories. From the present results it is suggested that some of the observed effects originally attributed to the action of unclustered ions are due to an emission of uncharged doublets during ionization by positive ions. The apparent velocity of the ions in air, as measured by the wind-pressure method, becomes greater as the current between point and plate increases. This is explained by the presence of a back discharge from the plate, which prevents the method from being applied with accuracy except when the current is small. Evidence is adduced in support of the view that the positive ion in pure hydrogen is a charged molecule. The amount of combination which a point discharge produces in hydrogen containing different percentages of oxygen and nitrogen and the form of the wind-pressure curves in these mixtures are discussed and explanations are offered.—*Phil. Mag.*, May.

Softening of Röntgen Rays in Passing Through Matter.—C. S. Sadler and A. I. Steven.—An account of an experimental investigation in which an apparent softening of a heterogeneous primary beam in the process of transmission through matter has been observed. This effect is shown to be connected with the selective absorption by a substance of those constituents of the beam which can readily excite its characteristic homogeneous radiation. Confirmation of this view has been obtained by an analysis of the primary beam.—*Phil. Mag.*, May.

Magnetization of Iron at Very Low Field Strengths.—W. Kummer, E. Gumlich and W. Rogowski.—Two letters with reference to the determination of the magnetization curve and hysteresis loss of iron at very low field strengths. For very low field strengths the exponent in Steinmetz's law for the hysteresis loss is not 1.6 but 3.—*Elek. Zeit.*, April 13.

Electrochemistry and Batteries.

Ions.—R. A. Millikan.—An account of an experimental investigation of the isolation of an ion with a precision measurement of its charge and the correction of Stokes' law. The method consists in watching a single very small particle of oil moving in an electric field and measuring the change of its motion while it switches electric charges. In conclusion the author gives the following summary of the most important of the molecular magnitudes, accurate values of which are made possible by an accurate determination of e. The Faraday constant is taken as $Ne = 9655$ absolute electromagnetic units; $e = 4.891 \times 10^{-10}$ electrostatic units, the smallest quantity of electricity capable of separate existence; $N = 5.922 \times 10^{23}$, the number of molecules in 1 gram molecule of any substance; $n = 2.644 \times 10^{19}$, the number of molecules in 1 cu. cm of any gas at 0 deg. C. and 76 cm; $a = 2.106 \times 10^{-16}$ ergs, the constant of molecular energy; molecular energy $\epsilon = aT$; $\epsilon_0 = 5.750 \times 10^{-14}$ ergs, the kinetic energy of agitation of a single molecule at 0 deg. C., and 76 cm $\epsilon_0 = 273\,a$; $m = 1.702 \times 10^{-24}$ grams, the weight of the hydrogen atom. Finally the weights and diameter of several molecules are given. The absolute weight of the hydrogen molecule is 3.4×10^{-24} gram; its diameter is 2.28×10^{-8} cm.—*Phys. Review*, April.

Units, Measurements and Instruments.

The Testing of Transformer Iron.—L. W. Wild.—When accuracy is the first consideration transformer iron is best tested in the forms of rings. For routine tests, however, ring specimens are impracticable on account of the cost of winding. For every-day testing transformer iron is generally obtained in strips, which are built up in some form of magnetic square, the strips being threaded into coils ready wound and fixed to a baseboard. The "interleaved butt-joint system with square corners" has been very largely employed. In this the strips are built up with butt joints, differently disposed in alternate layers, so that the joint of one layer is covered by continuous iron in the next. In the system employed at the National Bureau of Standards in Washington, which is called the Washington system, the strips of iron are interleaved with strips of paper or other suitable insulating material of the same thickness as the iron. They are then made up into four bundles, which are wound round with tape and inserted into the coils. Corner-pieces are then cut and bent, each to a different length, and these are inserted between the ends of the strips. A double clamp is finally placed at each corner and is tightened up so that the strips and corner-pieces are held fast together. The two chief objections to the interleaved system are, first, that the difference between the longest and shortest path presented to the flux is great, and, secondly, at the corners the cross-sectional area is increased to twice the normal. At low

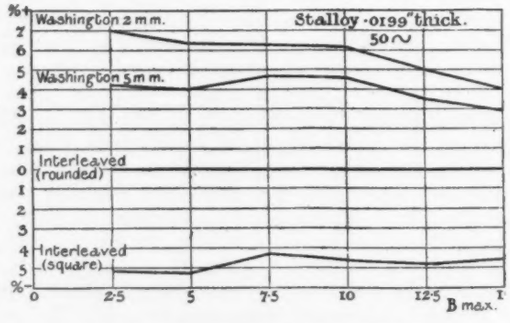


Fig. 3—Comparative Tests of Stalloy.

densities the flux will tend to crowd into the shortest path, and this should increase the specific loss as a whole. At high densities the decrease in permeability will tend to cause the flux to spread out more, and at very high densities, if there is no magnetic leakage, the results obtained will tend to come out correctly. The objection to the interleaved system can partly be overcome by rounding the corners. This renders the cross-section constant at all points of the circuit. The fault that

naturally occurs to one with regard to the Washington system is that the cutting and bending of the corner-pieces are likely so to increase hysteresis locally as to vitiate the total measurement. There is also the practical consideration that the operation of making and fitting the corner-pieces takes a considerable amount of time. In order to arrive at a general idea of the magnitude of errors involved, the author has made comparative tests of four specimens, employing all three systems, the strips used measuring 10 in. x 2 in. The specimens were of special transformer steels sold under the trade names of lohys and stalloy. The results for stalloy are given in Fig. 3. The author concludes that the Washington method is quite unsuitable for stalloy, and it is of rather doubtful utility for lohys. Secondly, if it should be decided that the interleaved method with rounded corners is the most accurate, it is hardly necessary to trouble about cutting the corners round. If the amount of waste material at the corners is deducted from the gross weight the results obtained will not differ by more than 1 per cent from the results that would have been obtained had the corners been rounded. It appears to the author that the interleaved method is still the best method of testing transformer iron available. It is generally agreed that if accurate results are to be obtained the strips must be annealed after being cut, and this can properly be done only by the manufacturer. There is no special virtue, then, in using wide strips.—Lond. *Electrician*, April 21.

Electric Insulators at High Temperatures.—W. W. STIFLER.—An account of experimental tests on certain electrical insulators at high temperatures. The insulating power of asbestos seems to break down sharply at about 900 deg. C. It rapidly recovers its insulating properties on cooling. Mica seems to remain an insulator up to about 1000 deg. C. It then breaks down very rapidly with increase of temperature. On cooling the insulating power is recovered quite slowly down to 700 deg. C., but below this temperature it recovers rapidly. On heating again, it follows the curve of recovery. Magnesium oxide is an excellent insulator up to 800 deg. C. When heated above this temperature it becomes quite conducting, but recovers its insulating power on cooling. Sodium silicate breaks down very rapidly above 200 deg. C. or 250 deg. C. The behavior of cæmentium is quite irregular. Apparently heating to 1000 deg. C. improves its insulating properties to some extent, though it cannot be relied upon much above 500 deg. C. The results in the cases of sodium silicate and cæmentium were to be expected from the fact that glass and porcelain conduct electrolytically at high temperatures.—*Phys. Review*, April.

Comparison of Two Self-Inductions.—A. ANDERSON.—A system consisting of a coil of resistance P and coefficient of self-induction L connected in parallel with a non-inductive resistor of resistance S has an inductance equal to $\frac{LS^2}{(P+S)^2}$. It is therefore possible by shunting a coil with a non-inductive resistance to reduce its effective self-inductance and to make the latter equal to that of another coil whose coefficient of self-induction is less. From this fact the following method of comparing the coefficients of self-induction of two coils is deduced. Referring to Fig. 4, the coils A and B, of which A has the higher self-induction, are placed in the two arms of a Wheatstone bridge, B in series with a resistor R of variable resistance, and A shunted by a variable shunt of resistance S. The resistance of CE is equal to the resistance of ED. If the resistance in the arm DF is equal to that in CF there will be no permanent current in the galvanometer, and if the self-induction in DF is equal to that in CF there will be no transient current when the battery key is put down after the galvanometer key. The method consists in varying S and R till both these conditions are fulfilled. Denoting the resistance of A and B by X and Y, and their coefficients of self-induction by L and N, there is obtained the relation

$$\frac{L}{N}=\left(1+\frac{X}{S}\right)^2 \text{ and } \frac{XS}{X+S}=Y+R.$$

It is possible that Y may be greater than $\frac{XS}{X+S}$, and in that case the resistance R should be in CF in series with the system consisting of A and S. Any inconvenience of moving the resistor R from DF to CF will be avoided by having variable resistances in both arms. The following is perhaps the easiest way of applying the principle of the method: The self-inductions L and N of the coils whose resistances are R and S are to be compared (Fig. 5). R and S are non-inductive resistors having resistances equal respectively to R and S. There is thus a balance for steady currents. The Q's are non-inductive shunts of equal resistance which are varied till there is no transient current. Then, $N=\frac{LQS}{R(R+Q)}$. Thus N must not be greater than $\frac{LS}{R}$, otherwise the shunts must be applied to S and S_1.—*Phil. Mag.*, May.

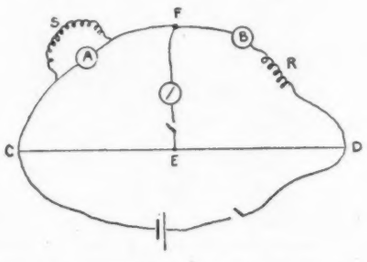


Fig. 4—Comparison of Self-Inductances.

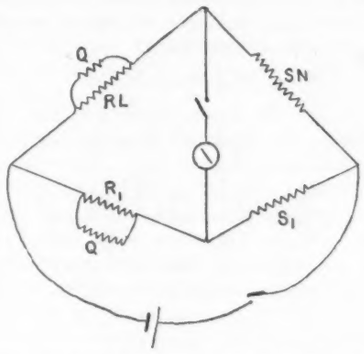


Fig. 5—Comparison of Self-Inductances.

Localizing Fractures in Cables.—G. WALD.—With reference to Black's test described in a recent article on the reduced current method for localizing fractures in submarine cables, the author gives a simple empirical formula by means of which the distance to the break may be found from each reading.—Lond. *Electrician*, April 21.

Faults in Three-Wire Systems.—W. E. ROGERS.—An article giving some practical rules on localizing faults in direct-current three-wire systems of smaller size.—Lond. *Elec. Review*, April 21.

Telegraphy, Telephony and Signals.

Telephone Statistics.—Statistical data on the status of telephony in thirty-one different countries (chiefly in Europe and not including the United States). In these countries telephony is furthest advanced in Germany, England, France and Sweden, where the number of telephone conversations in the year 1908 were 252,000,000, 46,000,000, 22,000,000 and 15,000,000 respectively. The total capital invested in telephone plants in these thirty-one countries is $288,000,000. If to this is added the capital invested in the United States ($820,000,000), in Canada ($25,000,000) and in Australia ($10,000,000) the total capital

investment in telephone plants in the world is $1,143,000,000.—*Elek. u. Masch.* (Vienna), April 9.

Telegraphy in the British Empire.—C. Bright.—A paper read before the Royal Colonial Institute in London on the telegraph communication now available between the different sections of the British Empire.—Lond. *Electrician*, April 28.

Congress of Telegraphy and Telephony.—F. Lueschen.—An account of the proceedings of the second International Conference of telegraph and telephone engineers recently held in Paris.—*Elek. Zeit.*, April 20 and 27.

Miscellaneous.

German Societies.—The annual meeting of the German Association (Verband) of Electrical Engineers will be held in Munich from May 29 to June 1, 1911. The annual meeting of the German Bunsen Society of Applied Physical Chemistry will be held in Kiel from May 25 to 28.—*Elek. Zeit.*, April 20.

Thunderbolts.—W. M. Thornton.—The author refers to the singularity of ball lightning which lies in the complete isolation of a gaseous sphere having no envelope, yet within which there is energy stored by previous electrical action. This is in the end liberated with explosive violence. He gives reasons for the assumption that these balls consist mostly of ozone in active recombination. The energy liberated on the transition of ozone to oxygen in the volume of fireball is sufficient to account for the explosive violence with which it bursts.—*Phil. Mag.*, May.

Industrial Finance.—L. Joseph.—A paper read before the (British) National Electrical Manufacturers' Association in which the author compares American and German with British industrial finance. He thinks that the progress made in the German electrical industries has been in a large measure due to the intelligent and most liberal assistance by the financial circles that have quickly grasped the importance of the new industry. An account is given of the extended discusssion, in which T. Rich, M. S. Myers, G. H. J. Hooghwinkel, H. Hirst, H. Oppenheimer and W. L. Madgen participated.—Lond. *Electrician*, April 28.

Book Reviews.

The Principles of Electro-Deposition. By Samuel Field. New York: Longmans, Green & Company. 383 pages, 121 illus. Price, $1.80.

This volume contains an elementary treatise on electro-deposition intended for the use of students, artisans and foremen. The fundamental principles of generators, of electro-deposition and of electrochemical measurement are clearly explained. The illustrations in the book are particularly good. The chapters relate to the following topics: Voltaic cells; properties of electric current; the generator; arrangement of apparatus in the circuit; switchboard and connections; resistances; measuring instruments; quantitative electro-deposition; processes preparatory to plating; general properties of solutions; hydrometers; deposition of copper; copper cyanide solution; deposition of nickel; deposition of iron, tin and zinc; deposition of silver; deposition of gold; electro-brassing; metal coloring; qualitative analysis; applications of qualitative analysis; quantitative analysis; the estimation of cyanide; estimation of constituents of copper solutions; recovery of metals. A series of useful tables is appended.

Although the descriptive treatment in the book is clear and good, it is marred and rendered unnecessarily complicated by referring to British weights and measures as distinguished from the metric. This is the weak point of the book.

Motion Study. By Frank B. Gilbreth. New York: D. Van Nostrand Company. 116 pages, 44 illus. Price, $2.

A plea for conservation of muscular and physical activity in the work of the artisan in any and all manual industries is contained in this little volume. It directs analysis to the scrutiny of the motions involved in any piece of labor, such as bricklaying, with a view to discovering what, if any, means can be adopted for eliminating unnecessary motions of the body or any of its members in the performance of this work, either with or without special tools, aids or new machinery. It is claimed that such analyses and procedures can reduce by a large percentage the time, labor and cost of work in nearly all trades and labor occupations.

The Slide-Rule. By C. N. Pickworth. New York: D. Van Nostrand Company. 119 pages, 34 illus. Price, $1. Twelfth edition.

This book represents a very practical little treatise for explaining the use of the slide-rule, its principles and methods of operation. Numerous examples are offered by way of illustrating the rules laid down. The history of the slide-rule's development is not discussed, but short descriptions of all the well-known existing types of slide-rule on the market are given. The greater part of the book is, however, devoted to the ordinary standard Mannheim slide-rule of four scales and a cursor, two scales being fixed and two moving on the slider. The book will be of service to those who desire to become acquainted with the principles that govern practical manipulation of the slide-rule.

Automatic Screw Machines and Their Tools. By L. C. Goodrich and F. A. Stanley. New York: Hill Publishing Company. 238 pages, 284 illus. Price, $2.

This is a complete and expert treatise on the construction and operation of automatic screw machines, describing with careful detail the mechanical means by which the wonderful, almost intelligent, sequence of operations which these machines perform is made possible. Numerous types of automatic machines are illustrated, including those of practically every leading American manufacturer. Instruction is also given in setting tools and cams for various jobs and in the preparation of tools for making unusual external or internal cuts. Complete tables of cutting speeds, tool feeds, etc., for screw-thread cutting, forming, boring, drilling and finishing are appended. In one interesting form of automatic machine, the Gridley turret lathe, described on page 86, the work spindle and cam shaft are driven by separate adjustable-speed motors, the controllers of which are operated automatically by cams on one of the drums. This arrangement gives a very flexible control of cutting speeds and feeds throughout the cycle of operations required to finish a given piece of work.

Leitfaden zum Elektrotechnischen Praktikum. By Dr. G. Brion. Leipzig and Berlin: B. G. Teubner. 404 pages, 380 illus. Price, 11 marks.

An elementary textbook of electricity and electrical engineering intended for the use of electrotechnical students. It describes electrical laboratory apparatus as used in technical schools and colleges.

The chapters relate to the following topics: Introduction; electric sources in technical laboratories; laboratory installation in the Dresden Technical College; apparatus for measuring current, voltage, load, electric quantity and electric energy; the measurement of such quantities; resistances and resistance measurement; condensers and coils; primary and secondary cells; magnetic measurements and apparatus; alternating-current and direct-current measurements; general remarks on testing electric machinery; direct-current machines; alternating-current and rotating-field machinery; transformers and induction motors; converters; the photometry of electric lamps.

The book is primarily intended as a textbook for the technical students at the Dresden Technische Hochschule, but it will serve as a textbook for electrical engineering students generally who are familiar with the German language.

HOW TO READ TELEPHONE CIRCUIT DIAGRAMS. By D. S. Hulfish. Chicago: Electricity Magazine Corporation. 260 pages, 570 illus. Price, $2.

The non-electrical man or one unaccustomed to deal with diagrams outlining complicated electrical circuits is often stampeded in the presence of an involved blueprint by a kind of stage fright which is wholly disproportionate to the real difficulty in understanding the message of the draftsman. Mr. Hulfish's book seeks to withdraw this sense of confusion by explaining the simple elements out of which the complicated network of the blueprints may be built. Incidentally, much of the current practice of subscribers', line and switchboard circuits is developed in the explanatory illustrations. The subject of wiring diagrams, intended to show mechanical details for the aid of the installer, is treated separately from that of simplified circuits, in which the electrical action alone is shown. In the explanatory text material accompanying the diagrams much that is obvious is included in the descriptions, but the purpose of the book is doubtless accomplished if it succeeds in robbing the average telephone diagram of some of its fancied terrors of intricate detail. One without experience in diagram reading will certainly find the careful perusal of this book a highly profitable undertaking if he has the patience to follow through its pages.

New Apparatus and Appliances

SMALL DIRECT-CURRENT METERS.

To meet the growing demand for small direct-current meters the Westinghouse Electric & Manufacturing Company a few years ago placed on the market its type L ammeters and voltmeters, which have recently been greatly improved and brought

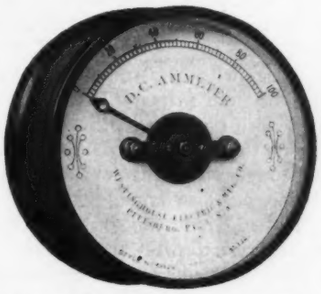


Fig. 1—Direct-Current Ammeter.

to an equality with many higher-priced instruments now on the market.

The meters are 5 in. in diameter, which makes them very convenient for use on small panels. At the same time the scale is 4 in. and uniformly divided, so that it is fully as legible as some larger meters. The movement of the meters is similar to that of the larger, higher-grade meters made by the Westinghouse company. The principle used is the D'Arsonval, or permanent-magnet, moving-coil principle, but its application in this case is unique, as the magnetic circuit has a single air-gap in which the coil moves pivoted at one edge. This arrangement results in several advantages. The single air-gap can have larger clearance for the same magnetic strength, making it easy to keep it free from dust or iron filings; the complete moving element can be removed and replaced without disturbing in any way the magnetic circuit or its strength, and the entire magnetic circuit can be magnetized, aged and tested as a unit, making variations unlikely. As shown in Fig. 2, the magnetic circuit is self-shielding and iron cases are not required to protect the instrument from stray magnetic fields.

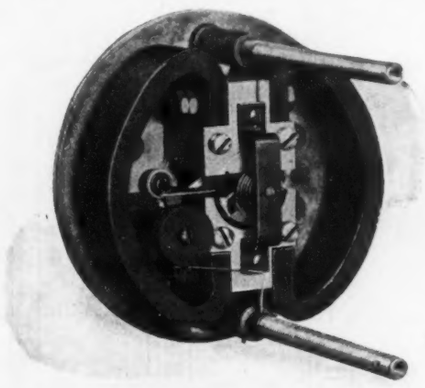


Fig. 2—Self-Shielding Magnetic Circuit.

The moving coil is wound on a light metal frame, the damping effect of which makes the reading dead-beat. The frame is carried on especially hardened steel pivots, bearing polished and carefully fitted sapphire jewels. As the coil is pivoted at one edge it acts as a counterbalance for the pointer. This reduces the total weight on the pivots, making friction a minimum and thus tending toward accuracy and long life. The meter scales are hand-calibrated, which eliminates any slight irregularities of the magnetic circuit that may exist. In case of injury to the calibration through overloads simple adjustments are provided for correction.

The cases of the meters are of molded hard rubber, giving the meters a finished appearance. The meters are attached to the panels by means of brass studs, which serve also as terminals. The line includes ammeters up to 300 amp and voltmeters up to 300 volts.

FEED-THROUGH SWITCH.

Many heating devices and small portable motor-driven devices, such as drills, vacuum cleaners, etc., are used with long, portable cords and are operated at a distance from the attachment plug or switch. For such cases a feed-through switch, which can be installed directly on the cord near the apparatus, permits of turning the current on or off wherever the device is being operated.

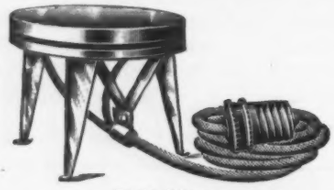
The new Cutler-Hammer switch of this type, shown two-thirds size in the accompanying illustration, has an inclosing

Feed-Through Switch.

casing made of a black insulating material, which is the result of years of experimental work. This composition is remarkably tough, has a handsome finish and can be molded with extreme accuracy, so that perfect alignment of the operating mechanism is possible. The rating of this switch is 6 amp and 125 volts, and the mechanism is the same as that used in the other Cutler-Hammer specialties. The switch has been approved by the Underwriters' Laboratories.

A BREAKFAST-TABLE ELECTRIC STOVE.

One of the advantages of the electric disk stove is that it can be used cozily on the table for the making of tea, coffee, toast and other creature comforts, including hot toddy, if one is thereto inclined. The stove illustrated herewith is conveniently



Disk Stove.

adapted for this purpose, being only 4 in. in diameter and consuming only 275 watts. It is finished in polished nickel and will be found useful in the sick-room, hospital and office, as well as in the home. It is made by the Waage Electric Company, 674 West Madison Street, Chicago.

LABORATORY RESISTANCE SET.

The laboratory resistance set here shown, while designed primarily for laboratory work, is arranged so that it can be used as a portable outfit at any time desired. The set consists of the switch dial form of Wheatstone bridge, four dials of ten coils each, with a one-dial bridge, the multiples being 0.01, 0.1, 1, 10 and 100. The coils are wound of manganin wire and are said to be accurate to 0.04 per cent in the regular instrument; higher accuracy can be obtained up to 0.01 per cent, thus allowing very accurate readings to be taken. The set should prove useful in central-station work, and in all com-

Portable Resistance Set.

mercial and technical laboratories where testing by Wheatstone bridge is done.

With the rheostat dials use is made of a design of brush which gives a uniform spring contact both on the arm running over the blocks and on the center ring. The brush is composed of a number of laminations of spring phosphor bronze with ground ends which slide over the contacts smoothly and evenly; the contact resistance is claimed to be negligible. The brush is set at an angle, so that in swinging over the blocks it does not mark or line the blocks. The contact surface on the center ring is equal to the contact surface on the stud, and hence on all of the switches the contact surfaces are equal, thereby making the instrument theoretically, as well as practically, correct. An important feature is the fact that there are no flexible leads or connections whatsoever, all connections being permanent and soldered, and the brush is so arranged that it swings in a complete circle in either direction, going from the highest value to the lowest value coil in any decade without having to be turned back over the intermediate blocks.

The set measures 12¾ in. in length by 10 in. in depth by 5 in. in height and weighs about 12 lb. It has been placed on the market by the Thompson-Levering Company, Philadelphia, Pa.

POLE-TYPE FUSE SWITCH.

In a distributing system covering large areas with a network of primary wires it is desirable to protect each branch circuit by a fuse which will localize troubles arising within the branch, also rendering the latter dead and guarding the public against contact with fallen wires, etc. The lineman hunting trouble or making repairs finds pole switches at branch points extremely helpful, and their use is now common for this purpose.

The Matthews fuse switch illustrated herewith combines the desirable function of both primary fuse and primary switch, serving as a fuse which operates positively, without possibility of danger or injury to men or line equipment, and can be cheaply and safely replaced when blown. The fuse is of the standard expulsion type, discharging its gases positively and breaking the arc and so eliminating the damage and danger of recurrent surges experienced with fuse blocks.

Fig. 1 shows the assembled fuse switch and Fig. 2 shows it with the carrier unhinged and the fuse removed from the carrier. The latter is of specially treated maple and on it are mounted the fuse contact clips. These in turn are connected to plates making contact (when the carrier is closed) with the stationary clips on the marble base at the rear, to which clips the leading-in wires are attached. The lower side of the iron box is closed by a slide of transite, provided with a hole opposite the expulsion fuse, through which the gases can discharge without raising the pressure inside the box, burning it or even rendering it temporarily alive.

The iron door is so designed that it prevents rain from

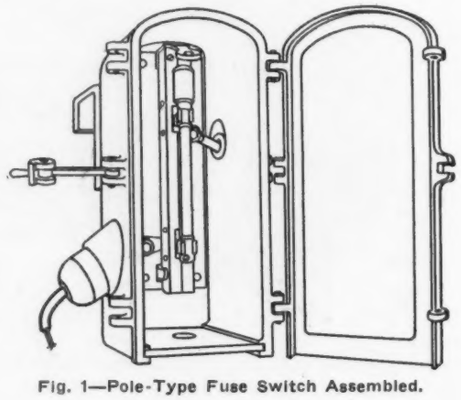


Fig. 1—Pole-Type Fuse Switch Assembled.

driving in and by the provision of hinge ears and latch lugs on both sides can be made to open right or left, as desired. The latch is simple but effective, and can be opened by striking it with the hook stick. This hook stick, as shown in Fig. 3, is used for pulling open the hinged fuse carrier, which is equipped with an eye at its upper end for this purpose.

The door may thus be opened and the switch pulled to its open position entirely by the aid of the hook stick. If it is desired to remove or replace the fuse the carrier (which is dead in its open position) can be unhinged by sliding it sideways on its pivot and lifting it free of the stud. It may then be removed from the box and the fuse replaced or changed without the slightest inconvenience or danger of shock. As the fuse element is of plain fuse wire a few spools of different

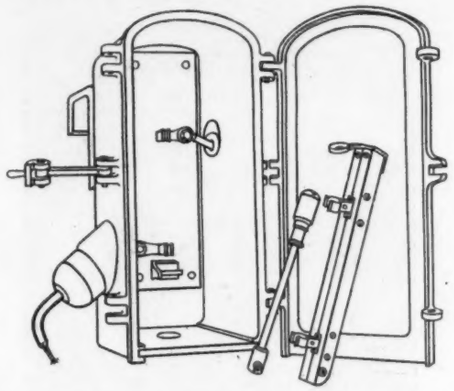


Fig. 2—Fuse Switch with Fuse and Carrier Removed.

sized wire will enable the lineman to change the rating of any fuse box without recourse to the complete assortment of high-voltage inclosed fuses otherwise required.

The heavy porcelain bushings through which the wires are led into the box are set at an angle which prevents moisture and dirt accumulating and entering the box. The bushings have been tested up to 19,000 volts, under rain conditions.

The use of the fuse switches described localizes troubles to the particular branch circuit where they originate without affecting the operation of an entire district. The opening of the branch fuses on swinging and partial grounds or shorts, not sufficiently severe to open the station breakers, also insures that dangerous live wires are not left exposed to cause accidents. Immediate notification of any trouble is also usually furnished headquarters, since the blowing of the fuse extinguishes service in a limited section, resulting in telephone calls from the consumers affected. The trouble crew can then

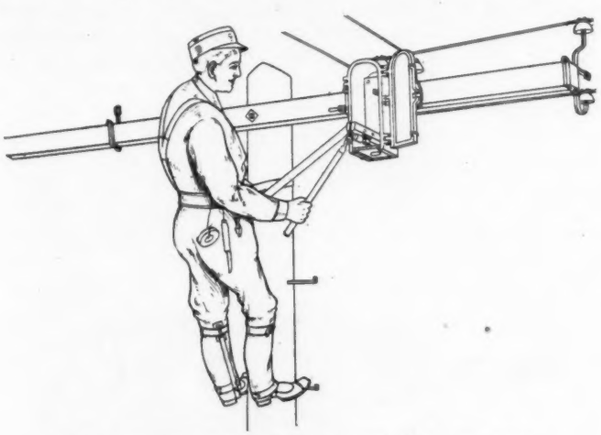


Fig. 3—Operating Pole-Type Fuse Switch with Hook.

be dispatched directly to the point of trouble, while the rest of the district remains unaffected.

W. N. Matthews & Brother, 219 North Second Street, St. Louis, who market this switch, say it is reasonable in first cost and inexpensive to install, since it hooks into place over the cross-arm and requires little space. It is safe to handle and operate, and its maintenance and fuse renewals are inexpensive. The fuse switch illustrated, which is of the type adopted by the Union Electric Light & Power Company of St. Louis after eighteen months' actual service, is designed to interrupt 75 amp at 6600 volts. It is built in styles for operation up to 200 amp and 17,000 volts.

SEMI-PARABOLIC STREET-LIGHTING REFLECTOR.

The street-lighting equipment here illustrated consists of an incandescent lamp placed at the focus of two parabolic reflec-

Fig. 1—Reflector for Center Suspension.

tors cut away at the rear to allow the lamp to be inserted and at the bottom to permit a downward distribution of the light. The equipment confines the light rays to useful directions, and

Fig. 2—Reflector for Goose-Neck Suspension.

hence gives a high efficiency of delivery. The candle-power distribution is non-uniform, being minimized in the upward and sidewise directions and augmented in the line with the

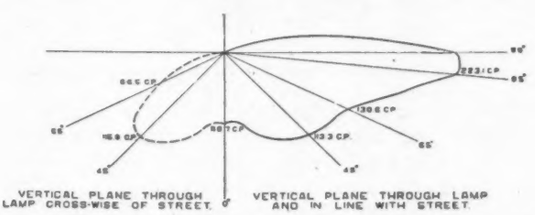


Fig. 3—Distribution of Light from 100-Watt Tungsten Lamp Unit in Reflector

street, as shown in Fig. 3. The result is a good distribution of illumination along the street surface, even at the midpoints between lamps widely separated, as indicated in Fig. 4.

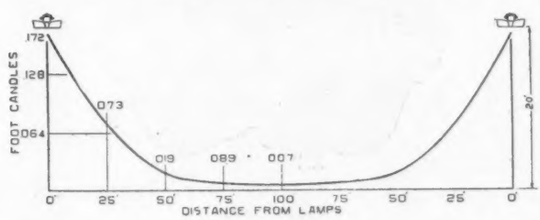


Fig. 4—Distribution of Illumination from Two 100-Watt Street Lighting Units.

This type of reflector equipment, built either for goose-neck or center suspension, has been placed on the market by the Benjamin Electric Manufacturing Company, Chicago, Ill.

MOTOR-GENERATOR EQUIPMENTS FOR CHARGING VEHICLE BATTERIES.

When the energy for charging vehicle storage batteries is obtainable at a voltage much higher than that of the battery or the current is alternating rather than direct it is necessary

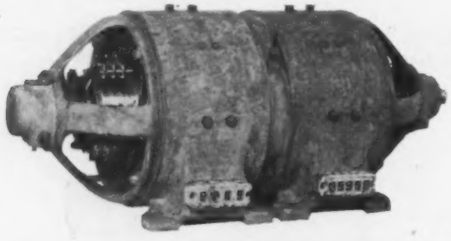


Fig. 1—Motor-Generator Battery-Charging Set.

to utilize apparatus for changing the voltage and current to the value and form demanded by the battery. When the supply is alternating mercury-arc rectifiers are frequently used, but when the supply is direct and the voltage high motor-generator sets must be employed if economy is desired, a voltage-reducing rheostat being very wasteful for this purpose.

In Fig. 1 is shown a motor-generator set consisting of a 250-volt or 500-volt direct-current motor directly connected to a 125-volt direct-current generator. These sets are built in ratings ranging from 0.125 kw to 12.5 kw.

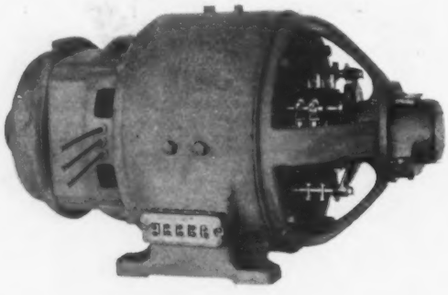


Fig. 2—Motor-Generator Battery-Charging Set.

Fig. 2 shows a set designed for use where alternating current is available. It consists of a 125-volt, direct-current generator driven by a polyphase motor wound for 110, 220 or 440 volts. These sets range in rating from 0.2 kw to 5.0 kw. A characteristic feature of these equipments is their freedom from complicated parts.

In Fig. 3 is shown a charging and running volt-ammeter designed particularly for use with electric vehicles. The instrument is of the permanent type, having two D'Arsonval elements.

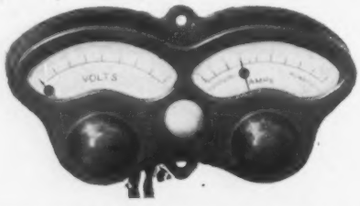


Fig. 3—Combination Volt-Ammeter for Automobile and Garage Equipment.

The ammeter is a millivoltmeter operating from an external shunt connected in series with the circuit; the voltmeter is self-contained, the series resistor being placed within the case. The scales are illuminated by a 2-cp lamp.

The above-described machines and apparatus are manufactured by the General Electric Company, Schenectady, N. Y.

MOTOR-DRIVEN MAGNETIC-CUSHION HAMMER.

The electrically driven hammer illustrated herewith is built upon the same principles as the hammer described in our issue for Dec. 2, 1909, but differs from the latter hammer in being more compact. The power is furnished by a series motor which drives a reciprocating plunger at the speed to produce

Fig. 1—Hammer in Service.

1800 blows per minute. However, the connection between the motor-driven reciprocating parts and the plunger or hammer element is not mechanical but magnetic, being furnished by a solenoid which lies around the sleeve of the tool element and provides an excellent cushion to prevent the strain and jar of delivery being felt upon the gears and motors.

The motor is totally inclosed, the steel frame forming a part of the tool casing. The brush holders are attached to the casing of the tool, so that the motor head may readily be removed and the brushes examined and repaired. Ball bearings are used throughout, so that the efficiency is high. The power consumption of the motor when the tool is in service is 220 watts, or about equal to the amount taken by two 32-cp carbon-filament incandescent lamps. The motor is wound for either 110 volts or 220 volts, direct current, and may be operated from any convenient lighting outlet.

The hammer complete is 13 in. long and weighs 25 lb. It has been developed for light chipping and calking, for use with drills, chisels, etc., in concrete, brick and stone structures, by the Electro-Magnetic Tool Company, Chicago.

It is claimed that this type of hammer has successfully with-

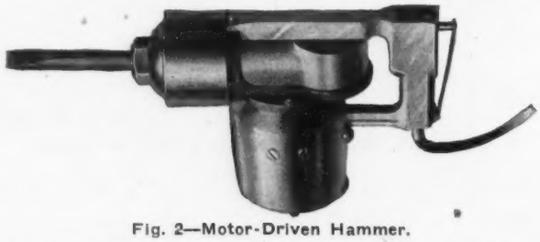
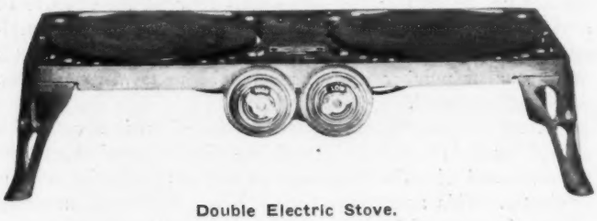


Fig. 2—Motor-Driven Hammer.

stood the test of commercial service as evidenced by the large number of the earlier models now in successful use. In comparison with air or steam hammers the electric type possesses an advantage in that all investment for air compressors, piping, hose, etc., is eliminated, thereby minimizing the first cost and maintenance.

DOUBLE ELECTRIC STOVE.

The double electric stove here illustrated fills the place of the two-burner gas stove, which of late years has become quite popular. This stove is said to be thoroughly fool-proof. It gives three degrees of heat. This device when used with an

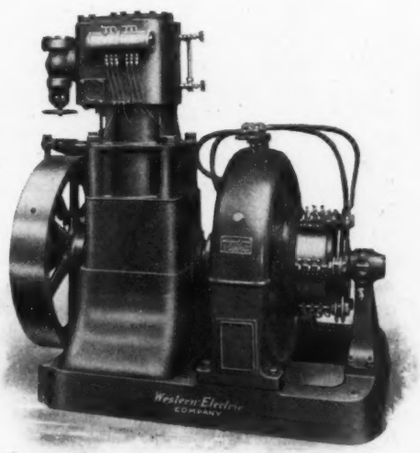


Double Electric Stove.

electric oven meets most housekeepers' summer cooking requirements and no doubt such a combination will be quickly adopted by wide-awake new-business departments. The stove has been placed on the market by the Diamond Electric Company, of Binghamton, N. Y.

SELF-CONTAINED STEAM-ENGINE GENERATOR SET.

In the accompanying illustration is shown a self-contained directly connected steam-engine generating set designed for electric service in isolated plants or marine installations, or as exciters in large central stations. The engine is of the vertical-



Steam-Driven Direct-Connected Generating Unit.

cylinder type and may be either single-expansion or tandem-compound, condensing or non-condensing, for pressures ranging from 35 lb. to 160 lb. The generator is a direct-current machine ranging in rating from 2.5 kw to 75.0 kw. The engine and generator are assembled on a common cast-iron base which extends the full width of the generator and provides ample base surface for foundation without increase of the floor area required. These sets are being placed on the market by the Western Electric Company.

FLEXIBLE INSULATED SHAFT COUPLING.

An insulated shaft coupling that can be used advantageously for connecting electric motors to pumps, sewing-machines, machine tools, wood-working machinery, etc., or gas engines to electric generators, is illustrated herewith. It consists of two cast-iron disks attached to the driving and driven shafts

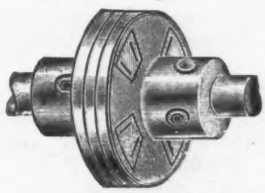


Fig. 1—Flexible Insulated Coupler.

and a central disk for supplying insulation and transmitting the torque from one terminal disk to the other. The coupling can be run in either direction; it is neat in appearance, perfectly

Fig. 2—Parts of Coupler.

balanced and adapted for revolving at high speeds. This coupling is manufactured by the Charles Bond Company, 520 Arch Street, Philadelphia, Pa.

WAGNER ENTERTAINMENT ON CHICAGO N. E. L. A. TRAIN.

Those who attended the convention at St. Louis last year have pleasant recollections of the courtesies and attentions devoted to the welfare and comfort of the delegates by the Wagner Electric Manufacturing Company of that city—automobiles to take them to and from the convention hall, candy for the ladies, cigars and cigarettes for the gentlemen, entertainment program on the special trains—evidence everywhere of careful thought and painstaking attention to details without being marred by obtrusiveness, as is sometimes the case with advertising of this character.

This year the Wagner company will provide the train entertainment features on the special train from Chicago. These features are entirely original with it through its advertising department, Ray D. Lillibridge, Incorporated, being first applied on the Street Railway Special train to Denver in 1909. The program consists of a train directory printed just before the train leaves, giving the name, address, business affiliation and location in the train of each person aboard, together with the schedule in detail and interesting features of the route; candy made by Wagner single-phase motors at the plant of the Belle Mead Sweets makers in liberal quantities for the ladies; cigars and cigarettes for the gentlemen; the now quite famous "Wagner Quality" cocktail at dinner for everybody, and complete arrangements for photographing the train and party, together with a print of the result with the Wagner company's compliments for each passenger on the train.

As there is no exhibit or general headquarters for the manufacturers this year the Wagner company has engaged the Louis XVI suite at the southeast corner of the second floor of the Hotel Astor as a rendezvous for its friends. While no hotel in particular has been selected as an official headquarters the Astor will house many of the officers of the association and the Monday night reception will be held there. The accommodations the Wagner company has selected are the same that have been occupied several times by President Taft on official visits to the metropolis and by such notable personages as the Crown Prince of Sweden and Admiral von Koester, who was

the Kaiser's representative at the Hudson-Fulton Celebration.

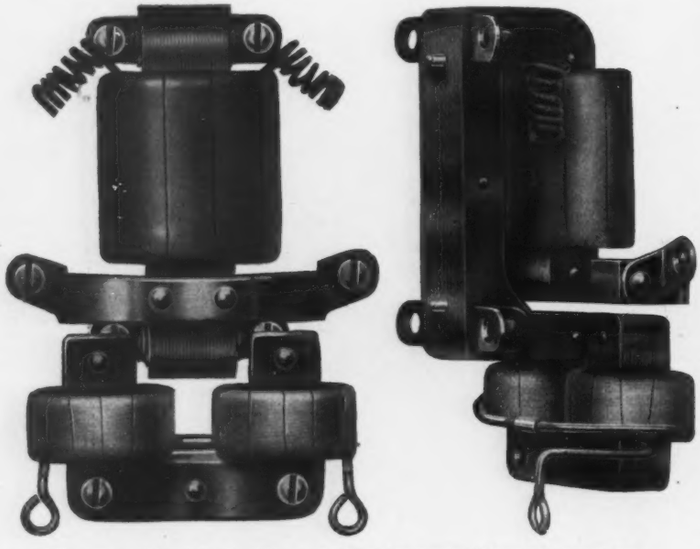
To further the value of these headquarters as a convenience the Wagner company has installed a direct-line telephone (Bryant 1426), doing away with the delay of incoming service and the expense of outgoing calls through the hotel switchboard.

The Wagner delegation will include Messrs. W. A. Layman, vice-president and general manager; F. N. Jewett, sales manager; E. H. Cheney, Chicago manager; John Mustard, Philadelphia manager; Brooks Faxon, Boston manager; E. W. Goldschmidt, New York manager, and Ray D. Lillibridge, advertising manager.

MAGNETIC CIRCUITS OF INDUCTION WATT-HOUR METERS.

The design and arrangement of the magnetic circuits of an induction watt-hour meter permit of a wide variation on the part of a designer as to the relations of the several elements entering into such systems, but in general it may be said that in this country the arrangement of magnetic circuits has been of two types. The first type is exemplified by those designs in which the series and shunt-field cores are embodied in one common magnetic structure, the several pole-pieces being so related above and below the armature of the meter as to produce the desired rotating-field effect.

In the common magnetic-circuit arrangement use is generally made of a pair of series magnet poles located on one side of the disk at a maximum radius and on the opposite side intermediate in position relative to the series-magnet poles above is placed a pole for the shunt magnet. In addition to the main shunt-magnet pole, auxiliary poles extend toward it from the return magnetic circuit at the sides, so that the flux from the shunt magnet through the disk is only a portion of the flux set up by the shunt coil in the lower portion of the laminated structure.



Figs. 1 and 2—Front, Side and Rear Views of Magnetic Circuits.

By this arrangement of a common magnetic structure for the several field magnetisms and the use of a leakage or partial flux proportional to the voltage, a meter is obtained which gives very accurate results over a considerable range in voltage and over commercial variations in frequency, wave-form, etc.

A disadvantage of this design, if it may be termed a disadvantage, is in the difficulty of taking apart the magnetic structure to get at the shunt or series coils in case of damage. There is also some disadvantage in the fact that this structure does not in itself exercise a shielding effect in preventing short-circuits through the meter weakening the permanent damping magnets.

In the second type of structure, differing radically in the details of arrangement, use is made of two large series coils without iron cores and acting upon an aluminum cup. These series coils are located on each side of a shunt magnet embracing the edge of the cup, the winding of the shunt magnet being within the cup and in series with a reactance coil in the lower part of the meter. In the original designs it was thought that the absence of iron in the series coils reduced the reactive or choking effect of these coils in the main load circuit, but experience proved that such reactive effect was negligible, and that a much smaller number of turns could be used when the iron core was employed.

In later designs, therefore, use is made of an iron core with pole-pieces for the two series coils standing in proximity to the armature and with the shunt magnet between the series coils as originally. This arrangement gives a meter of good accuracy under all commercial conditions, but has a tendency to weaken the permanent magnets on short-circuits unless use is made of a shielding device passing around from the series coils and embracing the cylinder.

A third form of meter having independent elements in the magnetic structure is illustrated herewith. This meter is fundamentally the same as the older Gutmann meter except that with the Gutmann meter the series coils were used without iron cores, so that relatively a smaller torque was obtained for the same expenditure of energy than in the present type.

In the latest meter the shunt magnet is a complete unit, both mechanically and electrically, being fastened in the meter independent of the structure of the series-laminated magnet. The latter magnet consists of a simple U-shaped yoke made up as a unit and riveted together, having on the other side of the disk from its poles a return magnetic circuit forming an air-gap between the poles and the return plate in which the armature rotates.

The construction shown in Figs. 1 and 2 permits of easy removal and repair of either shunt or series coils without disturbing the other element. More, the design of the curved magnetic return plate of the series magnet, with its laminations placed edgewise to the field, is such as to give a maximum radius of action for both the series and shunt-magnetic fields. As will be noted, the gap in the shunt-field core stands in between the poles of the series magnet, so that the several poles are in the closest possible relation.

Another advantage of this construction is in permitting the use of a laminated core for the shunt element having only a single air-gap. This insures uniformity and alignment in the gap, and reduces the magnetic leakage which must occur at each joint or gap in a magnetic structure, even when interlaced. Aside from the importance of the several elements of the magnetic circuit, the curved return plate is most useful in preventing severe short-circuits from affecting the permanent magnets as the return plate offers an effective closed path for the surplus magnetic flux from the series magnet during a condition of extreme overload or short-circuit. The shape of this return plate or yoke above the disk is such that the spreading lines of force under short-circuit conditions naturally tend to travel along the curved lines defined by the laminations of the return plate, so that with its front well forward of the plane of the series yoke no stray lines are left to act upon and weaken the permanent magnets.

Outside of the two general types of magnetic circuit described a great many other types and modifications of these types have been tried, but abandoned either on account of the complexity and consequent high cost of manufacture or because of some radical fault which resulted in meters being inaccurate over wide ranges in voltage, frequency, load, etc.

The magnetic structure illustrated herewith is employed in the induction watt-hour meter manufactured by the Sangamo Electric Company, Springfield, Ill.

ELECTROMAGNETIC ALTERNATING-CURRENT RECTIFIER.

The alternating-current rectifier shown herewith has been developed particularly for charging small storage batteries, such as are used for automobile lighting and gas-ignition circuits. The rectifier proper consists of a vibrating armature in connection with an electromagnet. The rectifier permits current to pass to the battery only when flowing in the proper direction, this action being attributable to the closing of the circuit to the battery by the electromagnet for only that half of the current wave which is the correct direction for charging the battery.

Combined with the rectifier proper is a resistor of the proper resistance to limit the value of the current reaching the battery and a two-coil transformer to deliver the proper emf for rectification for the battery. The rectified equipment is provided with

Electromagnetic Rectifier.

a lamp-cord terminal having an ordinary extension plug which can be inserted in any convenient lamp socket. The storage-battery connections are made at the two binding posts. It is quite immaterial which binding post is connected to the positive or to the negative terminal of the battery, since the charging will proceed satisfactorily regardless of the way the positive and negative terminals are connected to the rectifier. When so connected the operation begins automatically, the apparatus requiring no attention. If the alternating electric-supply current should be interrupted, the rectifier will automatically operate when the supply of current is re-established. If for any reason the rectifier should cease operating, due either to interruption of the alternating current supplied or to some difficulty in the rectifier itself, it always stops with the main contacts open so that the storage battery cannot be rapidly discharged.

The above-described type of rectifier has been placed on the market by the Wagner Electric Manufacturing Company, St. Louis, Mo., in two sizes for 3-amp and 5-amp direct current and for an emf sufficient to charge three lead cells in series. They are designed for use at 110-volt alternating current having any frequency between 57 cycles and 63 cycles per second.

IGNITION MAGNETOS.

The accompanying illustrations show a type of magneto suitable for dual high-tension ignition on one set of plugs. The low-potential current generated by the magneto is transformed by means of a non-vibrating coil to high-potential cur-

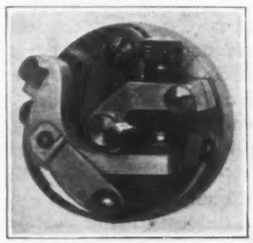


Fig. 1—Magneto Interrupter Mechanism.

rent for jump-spark work. They are made in different forms for use on small four-cylinder and six-cylinder motors for large, slow-speed four-cylinder and six-cylinder motors, for two-cylinder motors firing at 180 deg. apart and for single-cylinder two-cycle engines. All forms are essentially similar and differ only in general dimensions. Various types of coil boxes are built which can be used for both stationary and automobile work.

The magnets of high-grade tungsten steel are magnetized by the most powerful magnetizer extant, and the coils are ren-

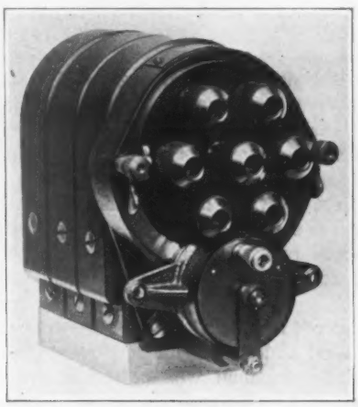


Fig. 2—Three-Magnet Six-Cylinder Magneto.

dered absolutely moisture-proof by a special process of insulation and impregnation. High-grade ball bearings are used throughout. The interrupter mechanism is specially designed to facilitate adjustment. Instead of using check nuts the fixed contact is secured by a pinch screw. With this arrangement the work of adjustment is a matter of but a few minutes, requiring only a screwdriver to loosen the pinch screw and a nail, or even a match, to turn the fixed contact screw. In fact, all the parts, which should be regularly inspected, are easily accessible and can be readily taken apart without the use of special tools. The switch is provided with an attachment for starting on spark. It is manufactured by the General Electric Company, Schenectady, N. Y.

BATTERIES FOR AUTOMOBILE LIGHTING.

There are two distinct systems for lighting of automobiles, the so-called "dynamo-lighting system" and the "straight storage-battery system." In the former a generator and battery are used together, the generator charging the battery while the car is running, or the energy may be taken directly from the generator, in which case the lighting circuit is automatically switched over to a battery when the car is running at slow speed or standing. In the straight storage-battery system all the energy required is taken from the storage battery, which is charged from some outside source. The fact that the storage battery is the foundation for satisfactory lighting of automobiles has resulted in the gradual development of a special type of battery for this purpose which has a higher capacity, higher discharge rate and a more substantial construction than the ordinary type of sparking battery.

The Willard Storage Battery Company, of Cleveland, Ohio, has put on the market a line of storage batteries for lighting purposes, the essential difference between which and the ordinary battery is in the normal discharge rate. An ordinary 6-volt battery rated at 60 amp-hours will give 1 amp for sixty hours, but will not give 6 amp for ten hours. The table shown below will give a general idea of what might reasonably be expected of a 60-amp-hour battery of the type here described.

Discharged at the 7.5-amp rate, battery will give 8 hours of service or a total of 60 amp-hours.

Discharged at the 5-amp rate, battery will give 14.5 hours of service, or a total of 72 amp-hours.

Storage Battery for Lighting.

Discharged at 1-amp rate, battery will give 92 hours of service, or a total of 72 amp-hours.

The highest discharge rate above given (7.5 amp) is the average total current consumption of an equipment for five lamps. From the above it will be seen that an output "rating" of a battery does not convey much information unless the rate of discharge is also given.

The battery here shown is made of three individual cells in which the elements are placed, the cells being made of a special composition of rubber which gives them strength without brittleness and at the same time makes them impervious to acid action.

The jars are placed in a wooden case. Between each jar and also between the jar and the outside case there are spaces filled with a semi-solid compound which acts as a cushion, thus enabling the battery to withstand the rough usage of automobile service without injury.

There is ample space between the plates and the first cover of the cell to allow for proper expansion during charging and also to allow one to see that the plates are fully covered by the electrolyte.

The binding posts and straps to which the plates forming the negative and positive groups are attached are a one-piece construction, and the plates themselves are lead-burned to the top-connecting strap so that the entire group of individual plates, top-connecting strap and terminal binding post form one integral unit.

The construction makes each cell an independent unit and there is no possibility for any connection between cells except such as are made from post to post above the top cover. This has the particular advantage of reducing the local action between cells to practically nothing. Moreover, any cell can be inspected or repaired without disturbing other cells. In the center of the top cover is placed a hollow vent plug having in its center a small hole to allow gases to escape when the battery is charging or discharging. The outside containing case is made of hard wood, which is chemically treated to make it acid-proof, and it is then covered with an acid-proof paint.

It is stated that with a battery of this kind and of the size suited to the maximum current required very satisfactory results have been obtained on "straight storage-battery system" at low expense for the original installation. The smaller types of these batteries are well suited for operating side and tail lamps.

NEW VENTILATING DEVICE.

The ventilating outfit shown in Fig. 1 is designed for placing simply and inexpensively into top sashes of windows, transoms or ends of sky-windows. The outfit includes 12½-in. motor-driven "Ventura" fan, cast-iron housing, cut worm-geared reversing mechanism, rod, bearing and handle, all ready for connection to plug or ordinary lamp socket. Fig. 2 illustrates an outfit adjusted for supplying fresh outdoor air. A special reversing mechanism makes it possible to discharge the air straight ahead, upward toward the ceiling, downward toward the floor, or at any intermediate location. A simple turn of the hand wheel (Fig. 1) reverses the outfit so that it exhausts from the room. Figs. 2 and 3 illustrate the simplicity of installation. To conserve the lighting effect and add to the appearance the filler which accommodates the ventilating set can be glazed as shown in Fig. 3. The electrical connection can be made from nearby plug or ordinary lamp socket. Any carpenter or millwright can install the outfit at small cost. This device, known as the "Ventura" electric ventilating set, is being marketed by the American Blower Company, Detroit, Mich.

Fig. 1—Ventilating Device for Window Sash.

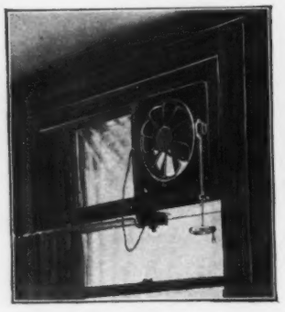


Fig. 2—Ventilating Fan Installed.

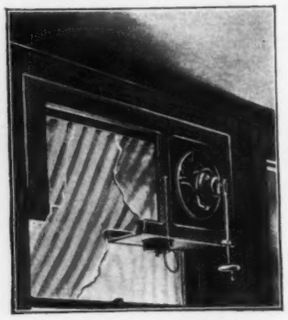


Fig. 3—Method of Installing Ventilator.

PORCELAIN STRAIN INSULATOR.

There are many conditions for which properly designed porcelain strain insulators are well suited. They are largely used in guy wires by street-railway and electric-supply companies. Groups in series are used at dead-ends to take the strain of and to insulate the line wires. The type of strain insulator

Porcelain Strain Insulator.

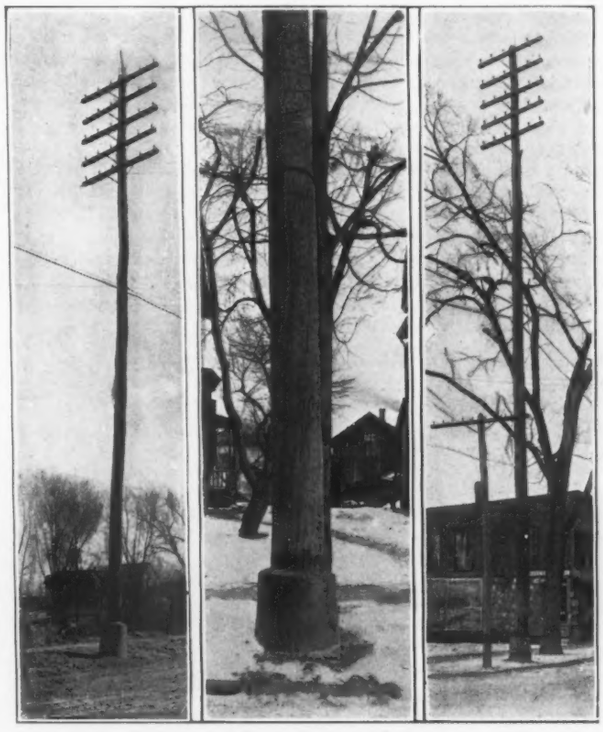
here shown is made of porcelain said to possess excellent mechanical and electrical properties for the purpose. The glaze is a dark brown, so that the insulators do not readily attract attention in the air. Sharp corners that would be apt to chip have been avoided and the shape of the grooves is such that the wires lie naturally in them. The breakdown emf when the insulators are dry is about 20,000 volts. The approximate ultimate tensile strengths of the insulators, when wired up in guy wires, are, respectively, 14,000 lb., 16,000 lb. and 23,000 lb. for insulators having maximum dimensions of 3⅛ in., 3½ in. and 5¼ in.

Even if an insulator fails either because of excessive stress or through an accident the wires that it carries cannot drop because they are interlinked. Two insulators are often installed in series so that if one breaks the other provides insulation, it being very improbable that two will break at the same time. This type of insulator is made by the Westinghouse Electric & Manufacturing Company, Pittsburgh, Pa.

CONCRETE REINFORCEMENT FOR DECAYED WOODEN POLES.

As is well known, the available supply of cedar poles and of chestnut poles, the two species of wood most widely used in electrical work, is rapidly diminishing, and in anticipation of the very limited amount of wood which will be procurable not many years hence, much work has been done on iron and reinforced concrete poles. The result of much of this work has been very satisfactory, and in one or two instances the cost has been brought down to a point comparable with that of wood. Experiments have not been completed along these lines as yet, however, and the central station companies are often in a quandary regarding the up-keep of lines, the poles of which have decayed. It has been estimated that fully 90 per cent of the pole-line troubles are due to decay at the ground line and not to actual breakage, as the upper part of the pole is invariably sound.

The Pittsburgh Reinforcing Pole Company, Pittsburgh, Pa., has a method by which a new lease of life is given to poles which have been rotted at the butt. By means of concrete reinforcing it is claimed that the poles can be made satisfactory for ten years' further use and the wood that would otherwise be scrapped be made to tide over the period of experimentation with substitutes. Usually the point of decay is right above and below the ground level, since the structure of the wood is there most susceptible to fungi and bacteria, which thrive in the condition of moisture found at this point. In the method used by the Pittsburgh Reinforcing Pole Company, the earth is removed for a distance of about 18 in. from the sides of the pole to a depth that will expose the solid portion of the butt. The decayed portion of the pole is then scraped out. One-half-inch steel rods from 3½ ft. to 6 ft. long and pointed at both ends, the upper end being bent at right angles to form a dog or point from 5 in. to 6 in. long, are used for reinforcing. The straight end of the rod is driven into the sound portion of the butt at an angle by the use of a special driving tool. The upper portion of the rod is then brought in toward the pole and the dog driven in to its full length. The length of the rod used is such as to permit the proper anchorage of its lower end in the sound wood of the butt and to allow the portion extending above the ground to be of sufficient length to span the rotted section of the pole and to be driven into perfectly sound wood. The points of the rods are usually driven into the pole from 12 in. to 18 in. above the ground level. Concrete is then filled in around the pole, replacing the decayed portion of the wood and forming a protecting sleeve or envelope. The concrete extends above the ground sufficiently far to cover the upper terminals of the rods and protect them from the elements, forming a sort of collar above ground and tapering from about 3 in. thick at the ground level to about 1½ in. at the top, where it is finished off by a frame designed for the purpose. Where the butt of the pole is partly rotted away, the rotten portion is removed and the space filled with concrete, thus providing an anchorage for the rods



Figs. 1, 2 and 3—Poles with Concrete Reinforcements

either in the solid wood of the butt or in the concrete itself. If the butt of the pole is entirely rotted away, a concrete base of slightly larger dimensions than the pole is used; the pole is cut off squarely and rests upon this concrete base, the upper portion of the rod projecting from the base and surrounding the pole being then bent in and the dogs driven home as in the first case. It is, of course, necessary to support the poles by means of tripods or temporary guying while the reinforcing is being done. The process is very simple and the average cost very low. Illustrations are given herewith of poles which have been reinforced by this process. From the standpoint of continuity of service, safety to workmen and cost, the process possesses advantages over the renewal of poles, as there is no necessity for handling wires, no interruption of service while reinforcing and no old poles to dispose of afterward. Decayed poles which have been reinforced by this method have been subjected to all kinds of tests, the tests demonstrating that the reinforcement can be made of any required strength, even up to that of a new pole.

Industrial and Commercial News

The Week in Trade.

WHILE there has been a far more cheerful tone during the week, and more improvement is reported in many lines than for many weeks preceding, the actual increase in the volume of new business has not been as large as expected, and totals are under the scale for the period of the year. In many quarters the belief is expressed that substantial increase in activity is still a matter for the future. Discussion of the Standard Oil decision continues in abundance, and opinion is rather divided as to whether or not the announcement of this important ruling has fully cleared the way for extension of trade. The dullness in general trade cannot be attributed solely to the delay in rendering the decision, and further developments along the lines of tariff legislation, ultimate crop returns and a more widely spread feeling of confidence seem needed before an active movement can become general. The business of the week, as a whole, has been of an encouraging nature. A better tone is evidenced in the metal markets. Many of the steel mills, however, are still operating well under capacity, and stocks of pig-iron are being increased at several of the furnaces. Retail lines have done a somewhat larger business, owing to the season, and wholesale and jobbing trades have made minor gains. Cotton markets are also slightly improved. The report on the number of idle cars shows an increase of only 272 between April 26 and May 10, against an increase of 953 between April 12 and 26. There is a feeling that more active purchasing on the part of the roads is to be expected with the advancement of summer. News of the excellent crop situation is greatly assisting the condition of the country. Business failures for the week ended May 18, as reported by *Bradstreet's*, were 235 as compared with 245 last week, 225 in the same week of 1910, 219 in 1909, 284 in 1908, and 165 in 1907.

The Copper Market.

FOLLOWING the Supreme Court decision, there was a temporary activity in standard copper, and prices advanced a fraction, but the movement induced little additional buying, and the net results at the close of the week showed a decline both in demand and prices. Inquiries are reported in greater volume from domestic consumers, over the week, and a sale of 5,000,000 lb. of electrolytic is said to have been made to foreign interests at 12 cents for July shipment. Another sale of 3,000,000 lb. is also reported for the same shipment. Aside from this, little new business is being obtained from either foreign or domestic interests. The announcement of the Supreme Court decision has caused revival of the possibility of a merger between the great producing interests. Any arrangement resulting in decreased production or in a more rational connection between supply and demand would be of benefit to the present market. With the probability of increased output from some of the new mines of the country the outlook for decrease in surplus stock is not improved. Business in finished products both here and abroad is not active. Prices for electrolytic copper have fluctuated abroad during the week, with the advances of the middle part of the week followed by reactions at the close. Many copper interests are looking for improvement within a short time, on the assumption that large consumers are short of stocks, and that in meeting these needs a large portion of the present surplus will be cleared, causing prices to reach a 13-cent level. The exports for the month, including May 22, now total 19,267 tons. The daily call on the Metal Exchange, May 22, quoted copper as per the accompanying table.

Standard Copper.	Bid.	Asked.	Settling Price.
Spot	11.85	12.00	.....
May	11.85	12.00	11.92½
June	11.85	12.00	11.92½
July	11.85	12.00	11.92½
August	11.85	12.00	11.92½

The London market, May 22, was as follows:

	Noon. £ s d	Closing. £ s d
Standard copper, spot	54 12 6	54 17 6
Standard copper, futures	55 3 9	55 8 9

Extreme fluctuations for this year:

	Highest.	Lowest.
Standard	12.30c	11.57½c
London, spot	£56 15 0	£53 7 6
London, futures	57 12 6	54 0 0
Best selected	60 5 0	57 5 0

Industrial and Commercial Notes.

Central Station for New Mexican Mines.—The Victor-American Fuel Company, which has been operating steam plants at three of its coal properties near Gallup, New Mexico, decided a short time ago to install a central station and transmit energy from this to its other properties. The company has constructed a fireproof power house of brick, with steel-supported roof, and is installing one 300-hp water-tube boiler and three 100-hp marine boilers. The plant is equipped with steel coal bunkers, which receive coal from a table about 200 ft. away. The ashes from each boiler are emptied into cars passing beneath the boilers, and when filled the cars are run out and the ashes emptied into a pit from which they are conveyed by an aerial tramway to an ash-dumping ground some 2000 ft. from the plant. The initial generating equipment will consist of two 500-kw, 2300-volt, three-phase, 60-cycle, General Electric horizontal condensing steam turbines, operating at a speed of 3600 r.p.m., and space will be left for two additional units. Two continuous-current, 15-kw, 125-volt General Electric condensing turbines operating at a speed of 4500 r.p.m. will serve as exciters. The switchboard will have blue Vermont marble panels, and will consist of two 15-kw, direct-current exciter panels, two 500-kw, alternating-current turbine panels, and four alternating-current, single-circuit feeder panels, with the usual instruments, all of which apparatus is to be furnished by the General Electric Company. There are at present four feeder circuits extending from the power house. One of these goes to the Hoaton mine, some 1¼ miles distant, where about 400 hp in motors are installed; another runs in the opposite direction to the Navajo mine, where there is approximately 800 hp in motors; the third circuit goes to the Bartlett mine, about 1½ miles away, where 275 hp in motors is installed; the remaining circuit goes to the town of Gallup, 5 or 6 miles away, where energy will be used for lighting and motor service. A voltage of 6600 was decided upon as a suitable potential for transmission, as some of the developments were situated from 4 to 6 miles from the plant. All the circuits are protected by General Electric aluminum-cell lightning arresters. In addition to the above apparatus for the generating plant the Victor-American Company has ordered the following apparatus from the General Electric Company for use at the three mines mentioned above: One 112-hp, three-phase hoist motor, with controller and rheostat; two 50-hp, 440-volt hoist motors of the slip-ring type, designed for heavy duty; one 250-hp, 440-volt, variable-speed hoist motor of the slip-ring type, with master controller contactor equipment; two 20-hp squirrel-cage-type induction motors for pumping service; three 35-hp, 440-volt variable-speed motors of the slip-ring type, with automatic self-starting device for driving fans, and three 150-kw, three 75-kw, three 50-kw, 6600-460-volt transformers.

Westinghouse Units for New Haven Road.—The New York, New Haven & Hartford Railroad has placed orders for four Westinghouse-Parsons turbo-generators for its Cos Cob station. These will be 4000-kva single-phase units, which will increase the generating rating of the station at 80 per cent power-factor from 12,000 kw to 28,000 kw. The present boiler equipment will be increased proportionately and the coal-handling plant will be rearranged and enlarged. The Fred. T. Ley Company, of Springfield, has been awarded the contract for erecting the addition to the present building in which the new machinery will be installed. The additional equipment of the station will be utilized for supplying energy to the electrified Harlem River branch, the New York, Westchester & Boston Railway, the Tarrytown, White Plains & Mamaroneck Railway, the local street railway system in Port Chester, N. Y., and the lighting system in Greenwich, Conn. It will also take care of future extensions of the main-line electrification east of Stamford, Conn. The cost of the new equipment will be in the neighborhood of $1,200,000.

Electric Equipments of Office Buildings.—C. E. Knox and C. O. Mailloux, of New York, who designed the elevator system of the Metropolitan Life Insurance Building, New York, have been retained to lay out the entire electrical equipment for the Municipal Office Building of the city of New York, construction of which is described in another section of this issue. No arrangements have been made for the installation of a private plant for this building. The connected load in lamps will be about 1800 kw, and there will be thirty-three elevators of the gearless traction type, which will have a lifting capacity of 3000 lb. at a rate of 600 ft. per minute. Mr. Knox states that this rate of speed is found satisfactory owing to the gradual acceleration acquired by this type of elevator, and that one of the most important features of the gearless traction type elevator is its freedom from danger of overrunning. The Lord Electric Company has been awarded the contract for the electrical equipment of the lower floors up to the first main floor, and will install the wiring, switchboards and elevator feeders. The latter will be furnished by the insulated wire department of the Diamond Rubber Company. In addition to the design of the equipment for the Municipal Building, Messrs. Knox and Mailloux will design the elevator system of the Woolworth Building now in course of erection in Park Place, New York City, in which thirty-four elevators will be installed. Among recent work designed by these engineers are the addition to the plant of the Masonic Hall, New York; the plant and elevator system of the Copley Plaza Hotel, Boston; the design of plant, elevators and lighting equipment of the Raleigh Hotel, Washington, D. C.; the elevators for the Post-Graduate Hospital, New York, N. Y., and the equipment for four new buildings at Columbia University, New York, N. Y.

Henry L. Doherty & Company Notes.—A convention of managers and secretaries of a number of the concerns controlled by Henry L. Doherty & Company will be held in New York on Friday and Saturday of this week. The attendance will be between eighty and one hundred. Many of these officials will also attend the National Electric Light convention. The Montgomery Light & Water Power Company has awarded a contract to Henry R. Worthington for a jet condenser for the 1000-kw turbine recently installed, and has purchased a 300-kw. motor-generator set from the Westinghouse Electric & Manufacturing Company. This is a 2300-volt, 60-cycle, two-phase unit, delivering energy at 550 volts. The Doherty company has awarded a contract amounting to some $100,000 for new steam-heating mains in Denver. This is the first instalment of the $500,000 which is to be used for new mains, as outlined in the *Electrical World* April 27. The Empire District Electric Company has purchased the Empire Power Company, which operates in Carthage, Mo. The Bristol Gas & Electric Company has entered into a twenty-year contract with the Wautaga Power Company for supplying the latter with 1000 hp for resale, this agreement becoming effective Sept. 1. Henry L. Doherty & Company have taken over the entire fourteenth floor at 60 Wall Street, New York, N. Y., their present address, and are remodeling this space for their increased needs. Henry L. Doherty sailed last Saturday for a three months' trip abroad.

Central-Station Service for Cotton Mills.—The Proximity Manufacturing Company, of Greensboro, N. C., which operates a 5500-kw generating station at its cotton mills, has entered into an agreement with the Southern Power Company, of Charlotte, N. C., for supplementary power. Since the Southern Company will furnish energy at 11,000 volts, 60 cycles, it has been necessary to provide a motor-generator set consisting of an 11,000-volt, 7750-kva, synchronous motor, operating at 400 r.p.m. and directly connected to a 7050-kva generator, which will furnish a 550-volt current at 40 cycles. The Panola Cotton Mills, of Greenwood, S. C., will take about 450 hp from the Southern Power Company. The plant was designed for motor drive throughout. The main groups will be equipped with 2200-volt motors and for the four-frame drive for spinning, employing 20-hp motors, the emf will be transformed to 550 volts. The motors for this installation, and the motor-generator set for the Proximity Manufacturing Company will be furnished by the General Electric Company.

More Telephone Dispatching.—Within a short time the Missouri, Kansas & Texas Railroad will be using the telephone to dispatch trains on both its Ft. Worth and its Dallas divisions. An order has just been placed with the Western Electric Company for forty-nine of its new selector and telephone equipments. The Dallas division runs from Dennison to Hillsboro via Dallas, a distance of 172 miles, and has a branch line of 22 miles from Dallas to Lewisville. On this division selector equipment for twenty-nine stations will be used. The dispatcher will be located at Dennison. The Ft. Worth division extends from Dennison to Hillsboro, a distance of 152 miles, with a branch 9 miles long extending from Egan to Cleborne. It will be equipped with selectors and telephone apparatus for twenty stations. The dispatcher for this division will also be located at Dennison. The Chicago, Burlington & Quincy Railroad, which was one of the first to use telephones for train dispatching, has just placed an order with the Western Electric Company for twenty-seven of its new selectors and associated telephone equipment for use on its St. Joseph division. This new circuit will be installed between Kansas City and Napier, Mo., a distance of 96 miles, and the dispatcher will be located at St. Joseph. For use with the telephones on this division a supply of the new Western Electric moisture-proof cords has been ordered. When this equipment is installed the Chicago, Burlington & Quincy will be operating over 2700 miles of track by the telephone.

St. Lawrence Water-Power Grants.—The Judiciary Committee of the New York State Senate has been considering a bill which repeals the law giving the Long Sault Development Company a franchise to develop water-power on the St. Lawrence River at Massena. The contention is made that the law under which the company received a perpetual franchise in 1907 was unconstitutional. The interests opposing the franchise hold that technically the land under the St. Lawrence River, under New York State control, is a part of the forest preserve, which the constitution states must be forever kept as wild land. John C. Crapser, who represented the company, offered a brief supporting the constitutionality of the grant, and stated that the company would spend $40,000,000 in development of power sites and in safeguarding navigation. Mr. Crapser said that the company, in accordance with the law, paid the State $15,000 last year, and would pay $20,000 this year for use of the river for power purposes.

Electrical Construction.—Among the items printed under Construction News in this issue are announcements of proposed new plants or considerable extensions to present plants at Decatur, Ala.; Grand View, Ark.; Mammoth Springs, Ark.; Fresno, Cal.; Greenville, Cal.; Pasadena, Cal.; Augusta, Ga.; Fort Sheridan, Ill.; Kendallville, Ind.; New London, Ia.; State Center, Ia.; Baltimore, Md.; Willmar, Minn.; Tupelo, Miss.; St. Louis, Mo.; Great Falls, Mont.; Albany, N. Y; Buffalo, N. Y.; Tarboro, N. C.; Eugene, Ore.; Claysville, Pa.; Edgefield, S. C.; Chamberlain, S. D.; Radford, Va.; Baraboo, Wis.; Superior, Wis.; Wausau, Wis.; Penetanguishene, Ont., Can.; Rouleau, Sask, Can.; Prince Albert, Sask., Can. and Montreal, Que., Can.

Gregory Electric Company Enlarges Plant.—A large addition is being made to the Gregory Electric Company's present building at Sixteenth and Lincoln Streets, Chicago. The new part has ground dimensions of 80 ft. by 125 ft. and will afford room for trebling the present testing department as well as for a brass foundry and a copper-smelting shop. Additional storage space will also be provided. The addition is a brick and steel structure and will be equipped with a 20-ton crane, making three large cranes in the whole establishment. When this is finished, about Aug. 1, the company will have one of the best equipped electrical repair shops to be found anywhere.

Cable Messages at Reduced Rates.—Following lengthy negotiations between Theodore N. Vail, president of the Western Union Telegraph & Cable Company, and H. L. Samuel, Postmaster-General of Great Britain, arrangements have been made by several of the cable companies doing business between this country and England for a reduction of 50 per cent on all non-code messages transmitted across the Atlantic, with the understanding that these are liable to a delay not exceeding twenty-four hours. This arrangement is not related to the proposed Anglo-American-Western Union co-operative plan mentioned in the issue of May 11.

Fire Alarm Equipment for New York.—Fire Commissioner Waldo, of New York City, has awarded a contract to the Star Electric Company, of Binghamton, N. Y., for the installation of 500 new fire-alarm boxes in the borough of Brooklyn. Hitherto all such equipment has been furnished by the Gamewell Fire Alarm Telegraph Company, of New York. It is stated that the bid of the Star Electric Company was at the rate of $88.66 per box; the former Gamewall rate was $165.

Hodenpyl, Hardy & Company.—Announcement is made by the firm of Hodenpyl, Hardy & Company, formation of which was mentioned in the issue of May 4, that the new company is interested in and will manage the major portion of the gas, electric and traction properties formerly managed by the recently dissolved firm of Hodenpyl, Walbridge & Company. The companies managed by the new firm are the Union Railway, Gas & Electric Company and the Commonwealth Power, Railway & Light Company, both of which have their executive offices with the firm. The Union Railway, Gas & Electric Company, through its constituent companies, the Evansville Gas & Electric Company, the Peoria Light Company, the Springfield Railway & Light Company, the Rockford & Interurban Railway Company, the Janesville Traction Company and the Consumers' Gas & Electric Company, owns and operates the gas properties in Evansville, Ind.; Springfield, Pekin and Peoria, Ill., and the electric light and power properties in the cities named, together with the street railway business of Rockford and Springfield, Ill.; Janesville, Wis., and controls the Rockford, Beloit & Janesville Railway Company, operating between Rockford, Belvidere and Janesville. The Commonwealth Power, Railway & Light Company, through its constituent companies, the Consumers' Power Company, the Michigan Light Company, the Cadillac Water & Light Company, the Grand Rapids Railway Company and the Saginaw-Bay City Railway Company, owns and operates the street railway properties in Grand Rapids, Saginaw and Bay City, Mich., and the Interurban Railway between the last two cities; the gas properties in Jackson, Kalamazoo, Pontiac, Flint, Saginaw and Bay City, Mich., and the electric light properties in these cities, together with those in Battle Creek, Lansing and a number of smaller cities and towns, all in Michigan. It also owns and operates a water business in Cadillac, and has developed important water powers on the Kalamazoo, Grand and Muskegon Rivers. It has large power developments under construction on the Au Sable River, from which it is expected to deliver power in the early autumn of this year, and plans additional developments as required.

Elevator Equipment for Chicago Building.—The recently erected Heisen office building in Chicago, which is the tallest building in that city, will be equipped with fourteen elevators of the overhead traction type, having a speed of 350 ft. per minute and a travel of 250 ft. The elevators will be equipped with interpole motors built by the Ideal Electric & Manufacturing Company, of Mansfield, Ohio, which are being installed by the H. J. Reedy Company, of Cincinnati, Ohio. These elevators will have three speeds, 175 ft., 250 ft. and 350 ft. per minute, and are being fully equipped with dynamic brakes and slowing-down features which are taken care of by the controller. The slow-down equipment brings the elevator from high to low speeds regardless of load, and makes accurate stops at landing an easy matter. Each motor is rated at 45-hp.

Electrical Ice Plant.—The Ensley Pratt Ice Factory, Ensley, Ala., with a daily output of 100 tons of ice, has recently been put in full operation and is one of the most up-to-date ...tificial ice plants in the South. The equipment consists of two Westinghouse alternators, ten induction motors and a standard switchboard. The deep-well triplex pumps are run by induction motors. The entire electrical outfit was installed by A. Froehlich, of Birmingham, who for many years was assistant foreman of electrical construction with the New York Edison Company. Mr. Froehlich will also electrify the large plant of the Birmingham Ice Company.

Mining Machines Installed.—After operating several years with mule haulage and hand-mining, the Darby Coal Company, of Darbyville, Va., has decided to install electric haulage and chain coal-cutting machines, and has placed an order with the General Electric Company for five 6-ton locomotives. Electric energy for operation will be obtained from the company's plant. With this installation the company expects to increase its output and also to effect a reduction in the cost of production.

Pennsylvania to Electrify Suburban Lines.—It is reported that the plans for the improvement of the Broad Street terminal of the Pennsylvania Railroad, at Philadelphia, include, among other changes, the electrification of the suburban lines. The board of engineers in charge of drawing the plans will report within a few days, and announcement of details is expected later.

Financial.

The Week in Wall Street.

TRADING on the New York Stock Exchange in the week following the Standard Oil decision was the largest for any week in over six months. Total transactions were 3,653,630 shares, as compared with 1,079,952 for the week preceding. The activity was most marked on Tuesday, in response to Monday's decision, the total for the day reaching 990,621 shares, accompanied by general advances in price. Since that time trading has been in diminishing volume, but much satisfaction is found in the maintaining of new price levels and in the extension of activity to a wide range of issues. The ultimate results of the Supreme Court decision continue to be the subject of extensive comment. The fact that large corporations, regardless of policy, were open to charges under the anti-trust law was considered a retarding factor in the affairs of the country. The nature of the decision has resulted in a widespread feeling that much of this uncertainty is now dispelled and that both new and existing enterprises are given a much firmer basis upon which to operate. Events of the week have shown a return of public interest in stock transactions, but the degree of interest is small as yet and will probably remain so, until the market becomes more stable. More progress will undoubtedly be made by cautious steps than by attempts to anticipate the outcome of present influences. When the results of present tariff legislation, the crop returns and the trend of general trade become more clearly defined trading in Wall Street will be more attractive to the general public. The activity of the past week caused a slight increase in demand for money, but loans continue to be made at former prices. Rates May 22 were: Call, 2¼@2½ per cent; ninety days, 2¾@3 per cent. The quotations in the tables are those for the close, May 22.

NEW YORK.

	May 15.	May 22.	Shares Sold.		May 15.	May 22.	Shares Sold.
All. Ch.....	7⅛*	8¼	1,600	Int. Met., pf.	52	53	5,000
All. Ch., pf..	28*	31	3,450	Mackay Cos..	90	92¾*	500
Amal. Cop...	63	67⅛	128,850	Mackay C.,pf.	76¼*	76½	100
Am. D. T...	20½*	20½*	———	Man. Elev...	135	137⅞*	420
Am. Loco...	37⅝*	43	5,200	Met. St. Ry..	15*	15*	———
Am. Loco., pf.	106¼*	108	300	N.Y.&N.J.Tel.	139½*	139½*	———
Am. Tel. & C.	82½*	82½*	———	Steel, com...	75⅞	80⅝	795,800
Am. T. & T..	148¼	148⅞	10.344	Steel, pfd...	118⅞	120¼	8,255
B. R. T.....	78¾	80⅝	53,655	W. U. T....	74¾	79¼	22,300
Gen. Elec...	156	160½	15,187	West'h, com..	69	74	26,900
Int. Met.....	18¼	18¾	5,180	West'h, pfd..	110	117	1,140

PHILADELPHIA.

	May 15.	May 22.		May 15.	May 22.
Am. Rys.....	44	44	Phila. Elec.....	16⅝	16⅞
El. Co. of A.....	12⅛*	12*	Phila. R. T.....	18⅜	18⅛
Elec. St. B'ty.....	53*	54	Phila. Trac.....	83½	83½*
Elec. St. B'ty., pfd..	30*	30*	Union Trac.....	46¾	46½

CHICAGO.

	May 15.	May 22.		May 15.	May 22.
Chi. Tel. Co.....	122*	123	Chi. City Ry.....	186*	186*
Met. El. Co.....	22⅛*	24¾	Chi. Rs., Ser. 1....	80*	80*
Met. El., pfd.....	67*	71	Chi. Rs., Ser. 2....	21*	21*
Nat'l Car.....	118¼	120*	Com. Edison.....	128¾	128½
Nat'l Car, pfd.....	120*	120*	Chi. Subways.....	4¾*	4¾*

BOSTON.

	May 15.	May 22.		May 15.	May 22.
Am. T. & T.....	148¼	149	Mex. Tel.....	4*	4*
Cum. Tel.....	150*	153¼*	Mex. Tel., pfd.....	6*	6½
Edison E., Ill.....	287	287	N. E. Tel.....	144½	146
Gen. Elec.....	156¾	161¼	W. T. & T.....	19*	19
Mass. E. Ry.....	18⅞	20	W. T. & T., pfd....	94¼*	96
Mass E. Ry., pf...	88½	89½			

*Last price quoted.
Shares sold for week May 15 to May 20.

Financial Notes.

Southern Utilities Merged.—Negotiation have been in progress for the consolidation of the New Orleans Railway & Light Company with interests of the American Cities Railway & Light Company. An agreement has been entered into by a number of the large stockholders of the New Orleans Railway & Light Company and Messrs. Bertron, Griscom & Jenks for the organization of a new company to acquire at least two-thirds of the preferred and common stock of the New Orleans Railway & Light Company and the stocks of the following named companies now owned by the American Cities Railway & Light Company: Birmingham Railway, Light & Power Company; Memphis Street Railway Company; Little Rock Railway & Electric Company, Knoxville Railway & Light Company; Houston Lighting & Power Company. The plan set forth in this agreement contemplates that the

new company will issue in payment for the preferred stock of the New Orleans Railway & Light Company its 6 per cent cumulative preferred stock and common stock at the rate of $83 1/3 par value of its preferred stock and $16 2/3 par value of its common stock for each share of preferred stock of the New Orleans Railway & Light Company, and at the rate of $35 par value of its said preferred stock and $25 par value of its common stock for each share of common stock of the New Orleans Railway & Light Company. Should all of the stockholders of the New Orleans Railway & Light Company deposit their stock under this agreement, which will require $15,333,333 of 6 per cent cumulative preferred stock of the new company and $6,666,666 par value of common stock of the new company, the new company will have outstanding capitalization as follows: $10,000,000 eight-year collateral trust 5 per cent bonds, $21,810,083 6 per cent cumulative preferred stock, and $16,643,416 common stock. The preferred and common stock issued over and above that reserved for exchange for the preferred and common stock of the New Orleans Railway & Light Company will be issued for the acquisition from the American Cities Railway & Light Company of the above-mentioned subsidiary companies, together with the sum of approximately $1,500,000 to be used by the new company for working capital. The collateral trust bonds will bear the date July 1, 1911, or thereabouts, maturing eight years from date, and 25 per cent, or $2,500,000, will be paid off at par at the expiration of five years from date of bonds by lot. The bonds will bear interest at 5 per cent for the first six years and 6 per cent for the seventh and eighth years, and will be secured by pledge of all stocks to be acquired by the new company. The bonds will be redeemable as a whole on any interest payment date at par and interest. The agreement is to be declared effective within forty-five days from May 15, 1911. Under this plan, the present preferred stockholders of the New Orleans Railway & Light Company will receive the same dividend return and $16 2/3 of common stock. Messrs. Ford, Bacon & Davis, who for a number of years have been in charge of the operation of the American Cities Railway & Light Company properties and who are familiar with the operations of the property of the New Orleans Railway & Light Company, will, it is understood, still continue their large interests in the new company and the direct charge of its engineering and operation. The shares of stock of the New Orleans Railway & Light Company held in the United States are to be deposited on or before June 15, 1911, with the Hibernia Bank & Trust Company and the Whitney National Bank, of New Orleans, or at the New York Trust Company, New York City.

Northern Colorado Power Company.—For the first time since its organization in 1906 the Northern Colorado Power Company on May 13 issued a financial statement, which shows that the company has assets amounting to $7,755,805. The capital stock is $3,000,000, the authorized bond issue $6,000,000, and the bonds actually issued $2,593,000. The company has absorbed the following concerns: Consumers' Electric Company, of Louisville, Col., supplying the Lafayette, Superior and Louisville district; the Longmont Electric Light & Power Company, of Longmont, Col.; Boulder Electric Light & Power Company, of Boulder, Col.; Berthoud Electric Light Company, Berthoud, Col.; Loveland Light, Heat & Power Company, Loveland, Col.; Laramie Light & Power Company, Laramie, Wyo.; Greeley Power & Light Company, of Greeley, Col., and Cheyenne Light, Fuel & Power Company, Cheyenne, Wyo. The company has built a power house at Lafayette for the interurban electric line, constructed a reservoir of 10,000,000 cu. ft. storage and purchased 110 acres of coal lands. The gross earnings in 1908 were $363,356 and in 1910 $447,940, while net earnings in 1908 were $33,874 and in 1910 $35,562. William J. Barker is president of the company.

New York Edison Earnings.—Despite the reduction in rates of the New York Edison Company announced in the *Electrical World* May 18, the earnings for 1911, from present indications, will be in excess of those for 1910. The new rates will apply to the second half of the calendar year, and the decreased income for this period will be balanced by the increase in net earnings for the first half of the year. George B. Cortelyou, president of the Consolidated Gas Company, which owns the stock of the New York Edison Company, is quoted as saying: "New York Edison's gain in gross is normal, in fact, a little above normal. Taking the record of the first four months, the gain in gross over 1910 has been a little larger than in 1910 over 1909." There was an increase of some $1,500,000 in gross earnings for 1910 over those of 1909, and also an increase of $1,100,000 in the net income available for dividends. With a decrease of $625,000 in these items in the second half of 1911, due to new rate schedules, there still remains an increase of some $500,000 in the surplus available for dividends, which would make the 1911 surplus $6,300,000 as compared with $5,821,346 in 1910.

Chicago Elevated Merger Expected.—Henry A. Blair, who has returned to Chicago from New York, where he had been making arrangements for financing a merger of the Chicago elevated systems, states that his negotiations have been satisfactory, and that the National City Bank of New York has agreed to furnish capital in the event of acceptance of his offer to the stockholders of the elevated roads affected. Meetings of the directors of the Metropolitan West Side Elevated Company and the directors of the South Side Elevated Railroad Company will be held early this week for the formal receipt of the offer. The promoters of the merger are largely Northwestern stockholders. It is said that the $30,000,000 notes which will be issued by the proposed holding corporation, which will also be the operating company in case the merger is effected, will bear 4½ per cent. These have been underwritten by Harris, Forbes & Company, and are to run for three years. Proceeds will be used for refunding the Northwestern Elevated 4 per cent bonds which become due in September.

Western States Gas & Electric Stock.—White, Weld & Company are offering $1,800,000 7 per cent cumulative preferred stock of the Western States Gas & Electric Company of Delaware at 100 and accrued dividend. This company owns all of the capital stock of the Western States Gas & Electric Company of California, which is the operating company and is a consolidation of the Humboldt Gas & Electric Company, the American River Electric Company, the Stockton Gas & Electric Corporation and the Richmond Light & Power Company. The Western States Gas & Electric Company of Delaware is controlled by the Standard Gas & Electric Company, which has a cash investment in excess of $1,500,000 in the common stock of the Delaware company. The Standard company, in turn, is controlled and operated by H. M. Byllesby & Company, of Chicago. The preferred stock of the Western States company, now offered, carries dividends at the rate of 7 per cent per annum, cumulative from April 1, 1911, is preferred as to principal and dividends and is redeemable at 115 and accrued dividends on sixty days' notice.

Kerr Turbine Company.—A reorganization has just been made of the Kerr Turbine Company, Wellsville, N. Y., and $125,000 new capital has been added. The stock interests of the company are now controlled by F. P. Merrill, of Hornell, N. Y., and P. B. Hanks, of Wellsville, who, as trustees, have directed the affairs of this company for the past two and a half years. Mr. Kerr is no longer with the company, his position as chief engineer now being filled by J. L. Moore, formerly a designer with the Westinghouse Electric & Manufacturing Company, and later in the engineering department of the Santa Fé Railroad. The present plant will be materially enlarged and a new machine shop is already in course of erection. It is the intention of the new company to incorporate into the Kerr turbine design changes which are based upon two years' experiments and which will improve the steam economy on all sizes from 15 to 20 per cent.

Kings County Electric Light & Power Company.—Gross earnings of the Kings County Electric Light & Power Company for four months ended April 30 were $1,588,796, which is an increase of $174,743, or some 12 per cent, over returns for the same period last year and is attributed to the efficient "new-business" campaign. The surplus available for dividends has increased $21,788, or about 6 per cent, in these four months. At the present rate operating returns will exceed $4,800,000. This will be offset to some extent if the prospective reduction of rates is adopted. A committee has been working for some time upon new rate schedules and a report will be presented to the directors of the company at the regular meeting on June 19.

Winnipeg Electric Railway Increase in Dividend.—A quarterly dividend of 3 per cent has been declared by the Winnipeg Electric Railway Company, placing the stock on a 12 per cent basis. The previous rate was 10 per cent per annum.

Ratification of Virginia Railway Merger.—The final steps in the consolidation of the Virginia Railway & Power Company with the Norfolk & Portsmouth Traction Company have been taken, and the agreement becomes effective July 1, 1911. An outline of the scope of this merger and of the capitalization of both participants was given in the *Electrical World* April 27. Corporate existence of the Norfolk & Portsmouth Traction Company ceases on July 1, 1911. The capital stock of the merged company is to be $20,000,000, of which $8,000,000 is to be preferred stock and $12,000,000 common stock. Prior to Jan. 1, 1914, the preferred stock is to draw non-cumulative dividends of 5 per cent per annum and after Jan. 1, 1914, the preferred stock is to draw non-cumulative dividends at the rate of 6 per cent per annum. The present $4,700,000 of preferred stock of the Virginia Railway & Power Company, and the present $7,450,500 of common stock, are to continue outstanding without change except that the certificates for the stock are to be exchanged for new certificates, which are to state the capitalization of the merged company. The stock of the Norfolk & Portsmouth Traction Company is to be exchanged for the stock of the Virginia Railway & Power Company on the following basis; In exchange for the present $3,000,000 of outstanding preferred stock of the Norfolk & Portsmouth Traction Company preferred stock of the Virginia Railway & Power Company is to be exchanged share for share. In exchange for the present $3,000,000 of outstanding common stock of the Norfolk & Portsmouth Traction Company, common stock of the Virginia Railway & Power Company to the amount of $4,500,000 is to be exchanged on the basis of one and one-half shares of the stock of the Virginia Railway & Power Company for one share of the common stock of the Norfolk & Portsmouth Traction Company. The remaining 3000 shares of preferred stock of the Virginia Railway & Power Company and the 495 shares of common stock are to be disposed of at the discretion of the directors. The officers of the company are: Frank J. Gould, chairman of the board of directors; William Northrup, Richmond, president; Fritz Sitterding, Richmond, Henry W. Anderson, Richmond, and R. Lancaster Williams, Baltimore, vice-presidents; Henry W. Anderson, general counsel; Guy Phillips, New York, secretary and treasurer; George B. Williams, Richmond, assistant secretary and assistant treasurer; W. J. Kehl, Norfolk, assistant secretary and treasurer; Frank J. Gould, William Northrup, Fritz Sitterding, Henry W. Anderson, R. Lancaster Williams, Percy M. Chandler, Guy Phillips, Nathaniel A. Campbell, George H. Taylor, Frank C. Briggs, F. W. Roebling, Jr., Caldwell Hardy, Fergus Reid and James L. Sellman, directors.

Public Utility Offerings.—Perry, Coffin & Burr, of Boston, are offering first-mortgage bonds of a number of public service corporations in various parts of the country. Portland General Electric 5s, due July 1, 1935, are offered at 101 and interest, to yield 4.93 per cent. These bonds are secured by a first mortgage on the entire property, rights, and franchises of the company, which does the electric service business of the city of Portland, Ore., and vicinity, serving a population of some 300,000. The company is owned by the Portland Railway, Light & Power Company. The latter is paying dividends at the rate of 4 per cent on its outstanding $25,000,000 capital stock. Gross earnings of the Portland General Electric Company for the year ended March 31, 1911, were $2,421,284; operating expenses and taxes were $884,595, leaving net earnings of $1,536,689. Plattsburgh Gas & Electric 5s, due September 1, 1939, are also offered at 95 and interest to yield 5.33 per cent. This company controls the entire gas, electric lighting and motor service business in Plattsburgh, N. Y., and vicinity. The bonds were issued with the sanction of the Public Service Commission for the Second District of New York, and are exempt from taxation to holders in that State. A dividend of 6 per cent was paid on the company's $100,000 preferred stock for the year 1910. Gross earnings of the company for the year ended December 31, 1910, were $97,438; operating expenses and taxes were $62,426, leaving net earnings of $35,012. Texas Traction 5s, due January 1, 1937, are offered at 95 to yield 5.31 per cent. The company owns and operates an electric railway 63 miles in length between Dallas and Sherman, serving a population of about 130,000. The territory is said to be one of the most fertile sections of the country. A large amount of the stock is held by local investors. By a special grant of the Texas Legislature the company has recently been granted the right to absorb the Denison & Sherman Street Railway Company, thereby making possible a continuous line from Dallas to Denison. Gross earnings for the year ended February 28, 1911, were $413,522; operating expenses and taxes were $256,042, leaving net earnings of $157,480.

Kansas City Railway & Light Passes Dividend.—In explanation of failure to declare the quarterly dividend on the preferred stock of the Kansas City Railway & Light Company, due June 1, R. J. Dunham, chairman of the board, says: "The dividend has not been passed because of reduced earnings, but because the company wishes to use its surplus earnings over and above interest charges for other corporate purposes, constructions, improvements, etc. The surplus earnings for the ten months ended March 31, 1911, over and above taxes and interest, were $793,305.92, and this was after exceptionally large charges to operating expenses for maintenance, exceeding by $207,000 the maintenance charges of the previous year." The last disbursement on the issue was 1¼ per cent in March.

Henry L. Doherty on Financial Situation.—An analysis of the condition of the country by Henry L. Doherty contains the following summary: "That, in all probability, we have two years of comparative inactivity ahead of us; we probably have two years of easy and cheap money ahead of us; the existing market value of true investment securities is from 20 to 33⅓ per cent below normal, and that during this two year period we will see a substantial recovery in market value by this class of securities; there is no reason to expect anything in the nature of a panic ahead or hard times; the next two years will see fewer investment securities created than the market can absorb."

Hudson Tunnel Bonds Taken.—W. G. Oakman, president of the Hudson Companies, has announced the sale of a block of Hudson & Manhattan Company's first mortgage 4½ per cent bonds in London. The sale was effected through Harvey Fisk & Sons. The amount of the bonds is not given, but the proceeds will furnish funds to meet minor obligations of the Hudson companies maturing Oct. 15, and for completing present construction work, including the connection with the Pennslyvania Railroad for the joint service to Newark, N. J.

New York & Queens Preferred Dividend.—In declaring a quarterly dividend of 1 per cent on its preferred stock, the New York & Queens County Electric Light & Power Company makes a reduction of one quarter of 1 per cent in its quarterly rate. Owing to a floating debt of $350,000, it was decided to place the dividend on a yearly basis of 4 per cent. The dividend is payable June 1 to stock of record May 26.

DIVIDENDS.

Blackstone Valley Gas & Electric Company, preferred, $1.50 per share, payable June 1.

Brooklyn Rapid Transit Company, quarterly, 1¼ per cent, payable June 15.

Cities Service Company, monthly, preferred, one-half of 1 per cent; common, ¼ per cent; payable June 1.

Detroit Edison Company, quarterly, 1¾ per cent, payable July 15.

Eastern Michigan Edison Company, quarterly, 1 per cent, payable July 1.

Northern Ohio Traction & Light Company, quarterly, three-quarters of 1 per cent, payable June 15.

Northern Texas Electric Company, quarterly, $1 50 per share, payable June 1.

Pensacola Electric Company, semi-annual, preferred, $3 per share, payable June 1.

Philadelphia Electric Company, quarterly, 1½ per cent, payable June 15.

REPORTS OF EARNINGS.

BIRMINGHAM RAILWAY, LIGHT & POWER COMPANY.

Period.	Gross Earnings.	Operating Expenses.	Net Earnings.	Fixed Charges.	Net Surplus.
April, 1911	$226,936	$117,438	$109,498	.....	.....
" 1910	214,829	114,669	100,160	.....	.....

KEYSTONE TELEPHONE COMPANY.

April, 1911	$98,986	$49,528	$49,458	$24,547	$24,911
" 1910	95,600	46,152	*49,538	24,705	24,833
10 m., 1911	$957,903	$477,427	$480,476	$244,672	$235,804
" 1910	931,352	466,980	464,372	252,969	211,403

KINGS COUNTY ELECTRIC LIGHT & POWER COMPANY.

April, 1911	$369,918	$186,973	$182,945	$105,965	$76,980
" 1910	342,413	163,260	179,153	103,602	75,551

NORFOLK & PORTSMOUTH TRACTION COMPANY.

April, 1911	$172,584	$99,092	$73,492	$62,233	$11,259
" 1910	155,338	91,988	63,350	65,412	*2,062

*Deficit

General News

Construction News.

BIRMINGHAM, ALA.—Preparations are being made by the Board of Commissioners to supply electricity from North Birmingham to light the municipal buildings in Birmingham. It is stated that the plant can be equipped to furnish the additional service for about $9,000.

DECATUR, ALA.—Plans and estimates have been submitted to the City Council by J. B. McCreary & Company, of Atlanta, Ga., for the construction of a municipal electric-light plant, to cost approximately $40,000.

GADSDEN, ALA.—The City Council has granted a franchise to L. L. Herzberg, Charles P. Smith, J. D. Dunlap and E. R. LeFevre to supply electricity and gas in Gadsden.

GANTTS QUARRY, ALA.—The Alabama Marble Company, it is reported, is installing an electric power plant, equipped with a 500-kw turbo-generator set The equipment of the plant includes a 30-ton crane. All machinery is equipped for electric motor drive. John Stephen Sewell is vice-president and general manager.

MONTGOMERY, ALA.—It is reported that contracts have been awarded by Richard Tillis for the construction of an electric plant as follows: For erection of building to Algernon Blair, of Montgomery, Ala., and to the Converse Bridge Company, of Chattanooga, Tenn., for steel work. Contracts for equipment have already been awarded. The cost of the entire plant is estimated at $500,000.

GRAVETTE, ARK.—Harry V. Forest, of Kansas City, Mo., is reported to have submitted a proposition to the City Council for the purchase of the municipal electric-light plant.

GENTRY, ARK.—The construction of an electric-light plant in Gentry is under consideration. Harry V. Forest, of Kansas City, Mo., is reported to be interested in the project.

GRANDVIEW, ARK.—Plans are being prepared by the North Arkansas Power Company, recently organized, for the construction of a hydroelectric plant to develop about 3860 hp for transmission to Northern Arkansas and Southern Missouri. The proposed work will include the construction of a tunnel 180 ft. long and concrete dam 300 ft. long to supply water under a head of 25 ft. It is understood that bids for construction will be asked by Aug. 1. E. H. Ingram and J. R. Neff, of Berryville, Ark., and E. D. Munger, of Springfield, Mo., are interested in the project.

JONESBORO, ARK.—It is reported that the Spring River Power Company is planning to erect hydroelectric power plants on Spring River in this section. F. R. Land is president of the company, J. D. Brown secretary, and W. H. Vaughn treasurer.

LITTLE ROCK, ARK.—Plans are being considered by the Little Rock Railway & Electric Company for the installation of a new intake system and condensing system. D. A. Hegarty, of Little Rock, Ark., is general manager.

MAMMOTH SPRINGS, ARK.—It is reported that the Mammoth Springs Light & Power Company is contemplating developing additional water power and extending its transmission lines.

BAKERSFIELD, CAL.—The San Joaquin Light & Power Company has awarded the contract for a 15,000-sq. ft. surface condenser and equipment to Braun, Williams & Russell, Inc., 503 Market Street, San Francisco, Cal.

BERKELEY, CAL.—The Oakland Traction Company has filed application with the City Council for two new street-railway franchiscs in Berkeley. One is for an extension of the street railway up Spruce Street to Los Angeles Avenue and thence to Northbrae Circle; the second asks for a change in running of the Grove Street cars on Adeline Street in South Berkeley.

COULTERVILLE, CAL.—The Merced gold mines in this vicinity have been purchased by W. F. Seeley, H. P. Dalton and ex-Governor Pardee, of Oakland. Work will soon begin on further developments at the mine, including the installation of electric power.

FRESNO, CAL.—A. G. Wishon, manager of the San Joaquin Light & Power Company, states that the large dam at Crane Valley will be completed by June 1. The dam will be 1900 ft. long and 100 ft. high, and will form a reservoir covering 1200 acres at an elevation of 3000 ft. above the sea. The dam cost about $1,000,000. The company has submitted a proposition to the City Trustees offering a reduction in the price of arc lamps throughout the city from $5.50 per month per lamp to $5 per month, on condition that the City Trustees agree to contract for at least thirty additional lamps, to be located in any part of the city designated by the trustees.

FRESNO, CAL.—Supervisor J. B. Johnson, who was appointed to investigate the cost and practicability of installing a power plant to supply electricity for lamps and motors for the county court house and hospital, has submitted a report prepared by Fairbanks, Morse & Company, of San Francisco, Cal. The estimates submitted call for the installation of two units, one consisting of a 100-hp gasoline engine direct-connected to a 75-kva, 2300-volt, three-phase, alternating-current generator, and the other of an 80-hp engine, direct-connected to a 60-kva, alternating-urrent generator, each engine to be equipped with a Neher generator, which permits the use of crude oil for fuel. The cost of the above units complete with necessary switchboards and all accessories for operation of plant, with necessary transmission line from hospital to court house and transformers at hospital installed complete, with the exception of building, is estimated at approximately $19,000.

GREENVILLE, CAL.—The Indian Valley Power Company, it is reported, is considering plans for enlarging its electric plant and installing new equipment this summer. A. C. Pratt, of San Francisco, Cal., is president of the company.

HOLTVILLE, CAL.—The installation of an electric-light plant in the Union High School is reported to be under consideration.

JACKSON, CAL.—The Sierra Blue Lakes Power Construction Company, it is reported, is making arrangements to begin work on construction of a large dam, located about one and a half miles below the mouth of Blue Creek.

LA GRANGE, CAL.—Negotiations have been consummated whereby John Hays Hammond has purchased the property of the La Grange Water & Power Company, which, it is said, will be consolidated with the two Tuolumne County power properties purchased about six months ago, which will practically place him in control of the entire hydroelectric output in this part of the State. The three plants combined involve an expenditure of about $20,000,000, and will have an output of 100,000 hp within a year. It is proposed to extend the transmission lines into San Francisco, Sacramento, Stockton, Marysville and other cities in central California.

LOS ANGELES, CAL.—Negotiations have been closed whereby Byron Erkenbrecher and H. F. Calvert, representing a syndicate of Los Angeles capitalists, have purchased the property of the Tejunga Water & Power Company. The price paid for the property is said to be more than $1,000,000. The property includes practically all the water rights on the Tejunga River in Los Angeles County, also ten dam and reservoir sites and rights of way in Tejunga Canyon for pipe and conduit lines. Nine of the reservoir sites are located in the Los Angeles National Forest Reserve, and the right to construct and operate this part of the company's system has been granted by the United States government. The company now has about 1700 acres under irrigation. It is proposed to utilize the water-power to generate electricity. It is estimated that about 8000 hp can be developed. Thomas Dack is president, and Homer A. Hanson is general manager of the Tejunga Water & Power Company.

MARYSVILLE, CAL.—The construction of a street car line to Knight's Park is said to be under consideration. It is reported that a company will be organized by local men to finance the project.

PALO ALTO, CAL.—The City Council has adopted an ordinance reducing the maximum rates for electricity for lamps and motors in Palo Alto. The rate for lamps was reduced from 10 cents to 7½ cents per kw-hour and for motors from 5 cents to 4 cents. The charge for electricity for domestic uses is placed at 3 cents per kw-hour. These rates will affect both the municipal electric-light plant and the United Gas & Electric Company.

PASADENA, CAL.—The City Council has passed a resolution authorizing bids to be called for one 1500 to 1650-kw turbo-generator set with Tirrill regulator and exciter for the municipal electric-light plant, to cost about $35,000. C. W. Koiner is general manager of the municipal electric-light plant.

QUINCY, CAL.—Notice of appropriation of 50,000 miners' in. of water of the North Fork of the Feather River has been filed by Leroy G. Brown in the office of the county recorder. It is proposed to utilize the water to generate electricity at three different locations on the stream. The present plan is to divert the water by means of a dam at a point about three and a half miles below Nevis and to convey it down the river within a quarter of a mile of Salmon Falls to a power house. The water will again be conveyed to a point about one mile below Bamboo Bridge and from there the water will be carried to a third power house near the Sunnyside mine. It is estimated that about 300,000 hp can be developed at the three plants.

REDDING, CAL.—Notice of appropriation of 500 in. of water in Bear Creek, in Shasta County, has been filed by C. W. Hill. The water is to be utilized to generate electricity.

REDDING, CAL.—The Siskiyou Light & Power Company, of Yreka, Cal., has been granted a franchise in Shasta County. The company proposes to begin work at once on the extension of its transmission lines to Castella, which, eventually, will be extended further south The company supplies electrical service in Klamath Falls and Ashland, Ore, on the north, and Sisson and Dunsmuir, on the south. Jesse W. Churchill, of Yreka, is president and manager

SAN BERNARDINO, CAL.—The City Council has awarded the contract for street lighting to the Pacific Light & Power Company at the rate

of $3.75 per lamp per month. A new street-lighting system will be installed, equipped with magnetite arc lamps.

SAN FRANCISCO, CAL.—Bonds to the amount of $1,000,000 have recently been sold by the Northern California Power Company, the proceeds of which will be utilized for improvements and extensions to its system.

SAN FRANCISCO, CAL.—The Spring Valley Water Company and the Pacific Gas & Electric Company have entered into a contract under which the latter will supply electricity to be used in connection with building the Calveras dam in Alameda County. Preparations are being made for the erection of a transmission line from Sunol to the Calveras dam site, a distance of 10 miles. The contract will amount to about $100,000.

SAN FRANCISCO, CAL.—The Northern California Power Company, which operates in the northern part of the State, is building a tunnel 6000 ft. long in connection with its Dry Burney Creek conservation and irrigation project. It is proposed to build a dam on Dry Burney Creek, which will form a reservoir of 1540 acres and provide sufficient power to generate 6000 hp. The tunnel is to be dug through a divide to convey water from Dry Burney Creek basin to Cera Creek basin. The water will be carried down to Cow Creek to Kilare, where the company has a 4000-hp plant, which will be increased to 7000 hp, now that more water is available. It is understood that additional machinery for the plant has been ordered. In addition, a secondary plant will be built down Cow Creek, using the water a second time and generating 3000 hp more. After passing through the last plant the water will be used for irrigating purposes.

YUCAIPA, CAL.—The installation of an electric-light system in Yucaipa is under consideration. The Edison Electric Company is contemplating extending its transmission line from the Mill Creek power house to this town. It has also been suggested that the water power in Burch Canyon be utilized to generate electricity to supply the service. It is estimated that sufficient power could be developed to supply electricity for residential lighting and to operate the pumps of the water system in Yucaipa.

AULT, COL.—The question of establishing an electric-light plant in Ault is reported to be under consideration.

COS COB, CONN.—Plans are being prepared by the New York, New Haven & Hartford Railroad Company for enlarging its power plant at Cos Cob. The present equipment of the plant includes four 3000-kw generators. An extension will be added to the plant providing for four 4000-kw generators, of which three will be installed immediately. The plant when completed will not only supply energy for operating the main line between New York and Stamford, but also for the Harlem division, the Stamford railway system, the New York, Westchester & Boston, of which a portion will be in operation next summer, the Mamaroneck, White Plains & Tarrytown line.

EAST HARTFORD, CONN.—The question of extending the street-lighting system to Hockanum is under consideration by the municipal committee. The Hartford Electric Light Company, of Hartford, Conn., supplies street lighting and electrical service in East Hartford.

FT. PIERCE, FLA.—Plans are being considered for installing water-works, electric-light and sewerage systems in Ft. Pierce. A bond issue amounting to $85,000 to pay for same will probably be submitted to the voters. F. M. Tyler is clerk.

JACKSONVILLE, FLA.—The Board of Bond Trustees has awarded the contract for driving piling foundations for the new electric-power plant to the Merrill-Stevens Company. The greater part of the work will be done by the board under the supervision of the Schofield Engineering Company, of Philadelphia, Pa.

AUGUSTA, GA.—It is reported that plans are being made for improvements and extensions to the local street-railway system, which will involve an expenditure of about $1,000,000. Among the improvements contemplated is increasing the output of the power plant by 3000 hp.

AUGUSTA, GA.—The Augusta & Aiken Railway Company is making arrangements to place its wires under ground on the principal streets in this city, work on which will soon begin. The American Telegraph & Telephone Company and the Postal Telegraph Companies will also put their wires under ground in the same district.

CLAXTON, GA.—A proposition has been submitted to the Mayor and City Council for the installation of an electric-light plant and water-works system in Claxton.

SANDPOINT, IDAHO.—Plans are being considered by the Northern Idaho & Montana Power Company for the extension of its transmission lines from Sandpoint to Hope, East Hope and Clark Fork.

WALLACE, IDAHO.—E. C. Meiklejohn, who is interested in the mining operations in the Coeur d'Alene, is endeavoring to secure the extension of an electric-transmission line to the Coeur d'Alene Nellie mine in the Osborn district and to the Mineral Point properties.

FORT SHERIDAN, ILL.—Sealed proposals will be received at the office of the Chief Quartermaster, Federal Building, Chicago, Ill., until June 16 for furnishing and installing a central power and heating plant at Fort Sheridan, Ill. Plans and specifications will be furnished on application to the above office. A deposit of $10 will be required for plans and specifications, which will be refunded upon return of same. Lt. Col. Thomas Cruse is chief quartermaster.

GIBSON CITY, ILL.—The Gibson Electric Light & Power Company has entered into a contract to supply electricity for operating the plants of the Gibson Iron Works and the McIntyre-Haight Canning Machinery Company.

MANITO, ILL.—The erection of a new power station for the municipal electric-light plant is reported to be under consideration.

PARIS, ILL.—It is reported that an election will soon be held to submit the proposition to issue $15,000 in bonds, the proceeds to be used for the improvements to the municipal electric light plant.

ROCK ISLAND, ILL.—Bids will be received at the office of the Commanding Officer, Rock Island Arsenal, Rock Island, Ill., until June 6, under circular 302, for furnishing an induction motor, polar-wound, slip-ring type.

KENDALLVILLE, IND.—Arrangements are being made to enlarge the municipal electric-light plant, the cost of which is estimated at about $25,000. The Council has authorized the superintendent of the plant to advertise for bids for a 400-kw generator.

SOUTH BEND, IND.—Preparations are being made by the Central Union Telephone Company for improvements and extensions to its system in South Bend, involving an expenditure of about $20,000. The work will include an addition to the switchboard capacity of the central exchange and the erection of new aerial cable.

TERRE HAUTE, IND.—The contract for the plant of the Trebert Gas Engine Company has been awarded to Roehm Brothers. The building will be 50 ft. x 156 ft. Considerable electrical apparatus will be installed. The company is moving its plant from Butler, Ind., to Terre Haute.

BELLE PLAIN, IA.—Plans are being considered to install electroliers in the business district of the city.

HAMPTON, IA.—The plant of the Hampton Electric Light & Power Company is reported to have been destroyed by fire, causing a loss of about $40,000. James J. Roe is president and manager of the company.

MASON CITY, IA.—Arrangements are being made by the Western Electric Telephone Company to rebuild its telephone line extending from Mason City to Charles City, and also the local service, the cost of which is estimated at about $25,000.

NEW LONDON, IA.—The City Council has decided to erect a new electric-light plant on the site of the present municipal plant. Contracts will be awarded for construction of the building as soon as plans are prepared.

STATE CENTER, IA.—Preparations are being made by the Town Council to rebuild the municipal electric-light plant, which was recently destroyed by fire. Contract for construction of power house will be let at once and bids will be called for new machinery. It is expected to have the plant completed and in operation within sixty days.

VILLISCA, IA.—The installation of a municipal electric-light plant in Villisca is reported to be under consideration.

WAUBEEK, IA.—It is reported that K. S. Tasker is contemplating the construction of a power plant on the Wapsipinicon River.

KENTWOOD, LA.—It is reported that surveys are being made for location of an electric-light plant and water-works system.

NEW ORLEANS, LA.—The Southwestern Traction & Power Company has awarded contract for the construction of the first division of its proposed railway from Spanish Lake through Iberia to Jeanerette, a distance of 17 miles. The railway when completed will be 65 miles in length and will connect Lafayette and Morgan City and intervening towns The power station and car barns will be located in New Iberia. The company will also supply electricity for lamps. F. W. Crosby, Tenegre Building, New Orleans, La., is president, and H. A. Mentz, engineer.

OLD ORCHARD, MAINE.—At a town meeting held recently the citizens voted to authorize the Selectmen to contract with the York Light & Heat Company, of Biddeford, Maine, to supply electricity for lighting the town for a term of five years. Under the terms of the contract the company is to supply eighty-six or more 60-cp incandescent lamps at $25 per lamp per year.

READFIELD, MAINE.—Preparations are being made by the Readfield Light & Power Company for extending its transmission line to the Readfield depot. A number of additional street lamps will be erected in Readfield.

WISCASSET, MAINE.—Negotiations are under way between the Wiscasset Electric Light & Power Company and the Portland Power & Development Company to supply electricity in Wiscasset.

ANNAPOLIS, MD.—Sealed proposals will be received at the Bureau of Supplies and Accounts, Navy Department, Washington, D. C., until May 31 to furnish at the Naval Academy, Annapolis, Md., a quantity of electrical conductor material, arc-lamp posts, steel conduit, outlet and switch boxes, vitrobestos, pipe covering, steel or wrought-iron pipe, gate valves and cast-iron tees. Applications for proposals should refer to schedule No. 3581. Blank forms furnished on application to navy pay office, Baltimore, Md., or to bureau. T. J. Cowle is paymaster general, U. S. N.

BALTIMORE, MD.—The Independent Ice Company is reported to have purchased the plant of the Atlantic Ice Company, Frederick Street. A 250-hp electric motor will be installed in the plant. It is said that

another unit of about the same rating will be installed early next year, which will give the plant an output of about 175 tons per day.

CATONSVILLE, MD.—Arrangements have been completed by the Baltimore County Water & Electric Company for the installation of new arc and incandescent lamps for street lighting in Catonsville. It is understood that the street lamps now in use will be transferred to Highlandtown. The cost of the new lamps is estimated at $5,000.

BOSTON, MASS.—Louis K. Rourke, Commissioner of Public Works, has awarded a contract to the Edison Electric Illuminating Company for the installation of 2000 tungsten lamps to replace gas lamps in the underground section of the city, extending from Roxbury Crossing to the water front. The electric lamps will cost $22.31 each per year, which is $1.27 less per year than paid for gas lamps under the present contract.

GREENFIELD, MASS.—Preliminary plans have been filed by Chace & Harriman for the construction of two dams on the Deerfield River, east of the Gardner Falls power plant of the Greenfield Electric Light & Power Company. The plans call for the construction of two concrete dams, one to be located about 1 mile east of the Gardner Falls dam and the other west of Dragon Brook.

WESTBORO, MASS.—The Selectmen have granted the Westboro Gas & Electric Company permission to erect transmission lines on Milk, Ruggles, Charles, Cross, High and Willow streets in Westboro.

KALAMAZOO, MICH.—It is expected that the proposition to install a municipal electric-light plant will be submitted to a vote at special election in connection with the charter revision.

MIDDLETON, MICH.—It is reported that a new electric street-lighting system will be erected in Middleton. J. A. Garrison is said to be interested in the project.

DULUTH, MINN.—The Duluth & Northern Traction Company, recently organized, is reported to be preparing plans for the construction of an interurban electric railway to extend from Hardy Street to the Tischer Road, 4½ miles in length. Charles P. Craig and J. G. Williams are interested in the project.

ROCHESTER, MINN.—Plans are being prepared by Earle D. Jackson, of St. Paul, Minn., engineer, for the installation of a new street-lighting system in Rochester.

WILLMAR, MINN.—Sealed proposals will be received by the State Board of Control, State Capitol Building, St. Paul, Minn., until May 29, for the erection of an administration building, men's and women's wards buildings, service buildings and connecting corridors, superintendent's house, power plant, laundry building and connecting tunnels, including the general contract work, plumbing work, heating and ventilating and electrical work, in accordance with plans and specifications, which are on file at the office of Architect Clarence H. Johnston, 715 Capital Bank Building, St. Paul, Minn. Plans and specifications are on file at the Builders' Exchange, St. Paul, Minn.; the Builders' Exchange, Minneapolis, Minn.; the State Bank of Willmar, Willmar, Minn., and at the office of the State Board of Control, St. Paul. Copies of the above plans and specifications may be obtained from the architect on payment of cost of duplication. Bids will be received collectively or separately.

TUPELO, MISS.—The City Council is reported to have engaged R. C. Houston, of Memphis, Tenn., to take charge of the construction of the proposed municipal electric-light plant, to cost approximately $20,000.

ANDERSON, MO.—Harry V. Forest, of Kansas City, Mo., is reported to be interested in the construction of an electric-light plant in Anderson.

MOBERLY, MO.—The citizens have voted to grant a gas and electric franchise to T. F. Fulkerson, of Trenton, Mo., for a term of twenty years, and a five-year contract for street lighting.

QUEEN CITY, MO.—Preparations are being made by the City Council to construct a municipal electric-light plant to cost $5,000. Proposals for equipment are now being received by W. M. Saxbury, Mayor.

ST. LOUIS, MO.—The City Lighting Department is preparing ordinances providing for adding 133 blocks to the underground wiring district in the city.

ST. LOUIS, MO.—The Dixon-Smith Engineering Company, Wright Building, St. Louis, Mo., consulting engineers, has been engaged by the Arcadia Country Club, of St. Louis, Mo., to prepare plans for the construction of a hydroelectric plant, to cost approximately $50,000. The proposed work includes the construction of a concrete dam and a 50-kw, three-phase, alternating-current electric plant, bids for which will be received until July 15.

GREAT FALLS, MONT.—The Great Falls Townsite & Power Company has filed a mortgage in favor of the Bankers' Trust Company, of New York, N. Y., to secure a bond issue of $15,000,000, of which $4,000,000 will be used to cover bonds issued for the development of the Rainbow Falls power site, now in operation, and $4,000,000 for the construction of a power plant at Great Falls. The proceeds of the remaining $7,000,000 will be used to equip the St. Paul railroad from Lewiston to Great Falls, a distance of 120 miles, for electrical operation. It is said that if the Lewiston-Great Falls line is operated successfully the entire St. Paul system will be equipped for electrical operation.

MEREDITH, N. H.—The Meredith Electric Light Company is reported to have offered to sell its electric plant to the town for $12,000.

BLOOMFIELD, N. J.—Action has been taken by the Board of Trade looking to the installation of a municipal electric-light plant. The board will recommend to the Mayor and Council that plans and estimates be obtained at once for installing an electric plant.

HADDONFIELD, N. J.—The installation of a municipal electric-light plant to cost about $40,000 is reported to be under consideration.

JERSEY CITY, N. J.—An agreement has been ratified between the Street and Water Board and the Public Service Corporation of New Jersey whereby the company will place its wires underground. Under the new agreement the company guarantees to place at least 2500 ft. of its electric-light wires in underground conduits on streets as designated by the board. The Street and Water Board reserves the right to order a second 2500 ft. annually, making a total of 5000 ft.

MOUNT TABER, N. J.—The rates for electricity for lamps have been reduced. The price, which was 20 cents per kw-hour, has been reduced to 17 cents per kw-hour for residential lighting and 15 cents per kw-hour for commercial lighting. The Eastern Pennsylvania Power Company, of Easton, has taken over the property of the Rockaway Electric Light & Improvement Company, which supplies electrical service in Mount Taber.

SEASIDE PARK, N. J.—The Borough Council, it is reported, is contemplating improvements to the electric light, water and sewer systems, involving an expenditure of about $35,000.

TUCUMCARI, N. M.—The electric plant of the Tucumcari Water, Ice & Power Company is reported to have been purchased by I. LaFite, of Denver, Col., for $22,000. It is understood that Mr. LaFite will take charge of the plant. It is expected that improvements will be made to the plant, a day service established and several miles of transmission line erected. About $10,000 will be expended on the system.

ALBANY, N. Y.—The Board of Contract and Supply has awarded a new contract to the Municipal Gas Company to furnish electricity to light the streets of the city for a period of five years, beginning June 21, under the terms of which the company is to supply the service from overhead wires at the rate of 22½ cents per arc lamp per night and from wires in underground conduits at 24½ cents, and 5½ cents for incandescent lamps. The Municipal Gas Company agrees to begin work of placing its wires underground before June 1, and to install magnetite arc lamps without expense to the city, and to install ornamental lamp standards, and also to make improvements and extensions to its plant, so as to insure an adequate supply of electricity for all purposes. Under the new contract the city will save $16.42 per lamp per year, or about $14,000 per annum on the 900 lamps used. The improvements to the electric plant and lighting system contemplated by the company will involve an expenditure of about $62,000.

BUFFALO, N. Y.—The American Agricultural Chemical Company, it is reported, is planning to erect a storage warehouse and power plant at its plant on Babcock and Lyman Streets and Erie Railroad, to cost approximately $50,000.

DELHI, N. Y.—The Delaware County Electric Light & Power Company has been authorized by the Public Service Commission, Second District, to execute a mortgage on all its property to secure an issue of $200,000 in bonds, of which $25,000 is to be sold at once at not less than par. The company is also authorized to issue $100,000 in capital stock. Of the proceeds of the $25,000 in bonds and $10,000 in capital stock, the sum of $2,000 is to be reserved for the purchase of additional electric equipment, $1,500 is to be used for the erection of a transmission line to the county house, and the balance is to be used for rebuilding the electric plant and distributing system formerly owned by the Delhi Electric Company, located in Delhi, Delaware County.

JOHNSTOWN, N. Y.—The Fulton County Gas & Electric Company has received authority from the Public Service Commission, Second District, to issue bonds to the amount of $92,000, the proceeds to be used for extensions and improvements to its plant and system, amounting to $95,322, the remaining $3,322 to be paid from the balance of the proceeds of the sale of $99,000 in notes, authorized by the commission March 31, 1910.

PORT JEFFERSON, N. Y.—The Public Service Commission, Second District, has authorized the Port Jefferson Electric Light & Power Company to issue bonds to the amount of $30,000. The proceeds of $8,800 to be used for the purchase of new equipment; $2,700 for expenses incurred in improving the plant, and $18,500 in payment of bills and accounts incurred for capital purposes.

ROCHESTER, N. Y.—The Rochester Railway & Light Company, it is reported, is contemplating the installation of Mazda incandescent lamps from Genesee Street through Elmwood Avenue past Mount Hope Cemetery and the State buildings in South Avenue through Highland Park to South Goodman Street.

UTICA, N. Y.—Sealed proposals will be received by the Board of Contract and Supply until May 24 for construction and extension of electric subways in Utica, N. Y. The work will include about 150,000 duct ft. of tile and appurtenances. Plans and specifications may be obtained from Stuart F. Day, secretary of Board of Contract and Supply.

CHARLOTTE, N. C.—The Piedmont & Northern Railway Company has placed a contract with the Westinghouse Electric & Manufacturing Company, of Pittsburgh, Pa., for ten 500-kw motor-generator sets. It is understood that the company will order additional equipment in the near future.

FAYETTEVILLE, N. C.—The Town Council has granted the Fayetteville Traction & Power Company permission to extend its lines through Haymount along Hay Street.

TARBORO, N. C.—Sealed proposals will be received by the Mayor and Board of Commissioners of the town of Tarboro, N. C., until June 15,

for water-works improvement, including the construction of a 500,000-gal. concrete filter plant, electric-driven turbine pumps and a 260,000-gal. concrete storage reservoir and auxiliary electric pumping station and 1 mile of 10-in. cast-iron pipe. Plans and specifications are on file at the office of the town clerk, Tarboro, N. C., and at the office of Gilbert C. White, engineer, Durham, N. C. Copies of specifications and proposal form, etc., may be obtained from the engineer. W. O. Howard is Mayor.

BOWBELLS, N. D.—The National Briquetting Company, of Kenmare, N. D., is reported to have applied to the Council for a franchise to install and operate an electric-light system in Bowbells.

FORMAN, N. D.—The contract for installing electric-light equipment for the new court house has been awarded to the McQuay Company for $1,550.

GLEN ULLIN, N. D.—Application has been made to the Council by C. E. V. Draper, of Mandan, N. D., for a franchise to install an electric-light plant at Glen Ullin.

GRAND FORKS, N. D.—It is reported that the construction of a dam in the Red River is under consideration.

COLUMBUS, OHIO.—Proposals will be received by the Board of County Commissioners until June 2 for the construction of a power house at the Franklin County Infirmary Farm. Howard & Marion are architects.

COLUMBUS, OHIO.—Bids will be received by H. S. Holton, Director of Public Service, for furnishing equipment for the municipal electric light plant as follows: 28,000 ft. No. 2, 204,000 ft. No. 4 and 60,000 ft. No. 6 triple-braided, weatherproof wire; remodeling switchboard, two 750-kva transformers, two 150-kva transformers, 7-in. top cedar poles as follows: 390, 40 ft.; 75, 45 ft.; 50, 50 ft.; 25, 55 ft.; 25, 60 ft.; 12, 65 ft., and 6, 70 ft.

GREENSPRING, OHIO.—The Village Council has granted a franchise to D. M. Scott to construct and operate an electric-light and power plant in Greenspring.

LIMA, OHIO.—The Western Ohio Electric Railway Company is contemplating the purchase of coal-handling machinery for its power house in the near future. F. D. Carpenter is general manager.

TOLEDO, OHIO.—The Board of Education has awarded contracts for electric wiring of the new high schools, known as the Morrison R. Waite High School and the Jessup W. Scott High School, to the Bailey Electric Company, of Cincinnati, Ohio, for $31,700.

EUGENE, ORE.—The City Water Board has asked the City Council to submit the proposition to issue $57,000 in bonds, the proceeds to be used for extensions of the municipal electric plant, to a vote of the people. It is proposed to install a complete distributing system to supply electricity for commercial lighting and for motors, and also the rehabilitation of the hydroelectric plant at Walterville.

NEWBERG, ORE.—The Yamhill Electric Company is said to be planning to enlarge its power plant within a few months. It is understood that the output of the plant will be doubled. C. J. Edwards is president and manager.

PAISLEY, ORE.—Arrangements are being made by local business men for the installation of an electric plant on the Withers Mill site on Summer Lake during the summer, to supply electricity for lamps and motors in Paisley. It is proposed to incorporate a company to operate the system.

ROSEBURG, ORE.—The local electric-generating plant, owned by J. L. & S. A. Kendall, which was recently destroyed by fire, will be rebuilt. The loss is estimated at about $50,000.

PANAMA.—Sealed proposals will be received at the office of the General Purchasing Officer, Isthmian Canal Commission, Washington, D. C., until June 15, for furnishing line material, including insulators, copper wire, copper sleeves, cross-arms and pins, etc., as per circular No. 633. Blanks and general information relating to the above circular may be obtained from the above office or the offices of the assistant purchasing agents, 24 State Street, New York, N. Y.; 614 Whitney-Central Building, New Orleans, La., and 1086 North Point Street, San Francisco, Cal. Captain F. C. Boggs is general purchasing officer.

CLAYSVILLE, PA.—The City Council has granted the Claysville Electric Light, Heat & Power Company a franchise to construct an electric plant in Claysville. The company has two sites under consideration, one in the borough and the other just outside. It is proposed to operate an ice plant in connection with the proposed plant, and possibly a laundry. A. C. Whitaker, of Wheeling, and M. G. Hertzog, of Claysville, are interested in the project.

PHILADELPHIA, PA.—The Pennsylvania Railroad Company, it is reported, is contemplating improvements to its Broad Street terminal, which will include equipping the suburban lines for electrical operation. Plans are now being prepared for the proposed work.

PITTSBURGH, PA.—The Duquesne Light Company has increased its capital stock from $500,000 to $3,000,000.

PITTSBURGH, PA.—The question of improving the street-lighting system in the downtown district is under consideration.

COLUMBIA, S. C.—The stockholders of the Columbia Railway, Light & Power Company have voted to adopt the resolution of the directors to increase the capital stock of the company from $1,600,000 to $3,000,000, the proceeds to be used for extensions and improvements to the system. The stockholders also voted to change the name of the company to the Columbia Railway, Gas & Electric Company.

EDGEFIELD, S. C.—At a special election held May 18 the citizens voted to issue bonds to the amount of $18,000, the proceeds to be used for the construction of a municipal electric-light plant. A. T. Padgett, L. T. May and B. F. Zimmerman were elected Commissioners of Public Works, and will have charge of construction and operation of the proposed plant.

HONEA PATH, S. C.—At an election held recently the citizens voted to issue bonds to the amount of $11,000, the proceeds to be used for the installation of a municipal electric-light plant. P. W. Sullivan is superintendent pro tem.

CHAMBERLAIN, S. D.—Preparations are being made by the Chamberlain Light & Power Company for enlarging its plant, which will involve an expenditure of about $12,000. The company proposes to establish a day service and make a number of extensions to its transmission lines during the coming year. It is understood that equipment for the proposed extension has been purchased.

FLANDREAU, S. D.—The installation of an electric-light plant in Flandreau is reported to be under consideration. The cost of the proposed plant is estimated at about $20,000. Mr. Shaver, of St. Paul, Minn., is said to be interested in the project.

KNOXVILLE, TENN.—The Knight-Weller Company, which owns coal, iron, copper and other mineral lands in Tennessee, Virginia, West Virginia, North Carolina and South Carolina, and timber lands in Tennessee and North Carolina, is developing some of its timber land under contract, and others will be used by the company for charcoal in electric smelting of ores. The company is contemplating developing its water powers, bids for which have already been asked. One will develop from 5000 to 10,000 hp, which will be used for mining and smelting purposes. The main office of the company is located in the District Bank Building, Washington, D. C., and the local office in the Empire Building, Knoxville, Tenn.

LIVINGSTON, TENN.—Plans are being considered by the Livingston Light & Power Company for the installation of electric equipment. W. W. Hendrix, of Cookeville, Tenn., is reported to be interested in the project.

McKENZIE, TENN.—Bonds to the amount of $40,000 have been voted, the proceeds to be used for extensions to the electric-light and water-works systems and street improvements.

AUSTIN, TEX.—It is reported that W. P. Carmichael, of the Carmichael Construction Company, of St. Louis, Mo., will submit a proposition to the City Commission for the reconstruction of the dam across the Colorado River in Austin and the installation of a hydroelectric plant. Grant Hornaday, president of the Midland Construction Company, of Fort Scott, Kan., is also negotiating with the City Commission with the same object in view.

LONGVIEW, TEX.—It is reported that bids will be received about the middle of June for the installation of an electric-lignt system, and for sewers and paving, for which bonds to the amount of $90,000 were recently voted. P. E. Green, of Chicago, Ill., is consulting engineer.

McALLEN, TEX.—A. L. Strang, who was recently granted a franchise to install and operate an electric system in McCall, is planning to install a plant to cost about $10,000.

NEW BRAUNFELS, TEX.—The City Council has adopted preliminary plans prepared by the W. K. Palmer Company, of Kansas City, Mo., for the construction of a large reinforced concrete dam across the Guadalupe River, near New Braunfels. The proposed dam will supply power for operating a large hydroelectric plant which the city proposes to install.

PALESTINE, TEX.—Tucker Royall and associates are reported to be promoting the construction of an electric street-railway system in Palestine.

ROSENBERG, TEX.—The City Council is reported to have accepted the proposition submitted by a Houston engineering company to install an electric-light plant in Rosenberg.

OGDEN, UTAH.—The Merchants' Light & Power Company, of Ogden, Utah, has awarded the Falkenau Electrical Construction Company, of Chicago, Ill., the general contract for the complete construction and installation of its system. Plans and specifications were prepared by H. A. Straus, of Chicago, Ill., consulting engineer. The Merchants' Light & Power Company was recently awarded the contract for street lighting in Ogden.

SALT LAKE, UTAH.—The City Council has appointed a committee, consisting of the engineering committee and the Mayor and City Engineer, for the purpose of investigating the offer of C. W. Earl to sell the city a site in the American Fork Canyon for a municipal electric-light plant. The site is located at the junction of the American Fork River, the Deer Creek and Silver Creek, about 30 miles from Salt Lake City. It is estimated that from 2500 hp to 3000 hp could be developed. If the site is purchased it is not expected that any immediate steps will be taken by the city toward the construction of a plant.

MONTPELIER, VT.—Arrangements have been made by the Consolidated Lighting Company to extend its service to the town of Washington. It is proposed to extend the transmission line from East Barre, a distance of about four miles. The company is also making investigations in the town of Orange with a view of extending its lines to supply electricity for lamps and motors in that place.

WATERBURY, VT.—Moody & Almon, of Montpelier, Vt., are contemplating extending a transmission line from their plant at Moretown to Waterbury to supply electricity for lamps and motors in that village.

DANVILLE, VA.—At an election to be held June 27 the proposition to issue $150,000 in bonds, the proceeds to be used for improvements to the municipal electric-light plant and paving will be submitted to a vote of the people.

DARBYVILLE, VA.—Arrangements are being made by the Darby Coal Company for the installation of electrical power to operate the machinery in its mines. Orders have been placed with the General Electric Company for five 6-ton locomotives. Electric haulage and chain coal-cutting machines will be installed. Electricity for operating the machinery will be usupplied by the company's own plant.

RADFORD, VA.—A new charter has been obtained by the Virginia Power Company under the name of the Dominion Power Company. Extensive water-power developments are contemplated by the company on different rivers. About 100,000 hp will be developed, of which 30,000 hp is for local distribution. About 500 miles of transmission lines will be erected. The first plant will develop about 10,000 hp. The entire project will involve an expenditure of about $12,000,000. J. J. Mott, of East Radford, Va., is president, and Robert A. Schott, of Radford, is chief engineer.

ROCKY MOUNT, VA.—The capital stock of the Franklin County Telephone Company has been increased from $7,000 to $12,000.

BREMERTON, WASH.—The Puget Sound & Southern Railway Company is reported to have applied to the Council for a franchise to supply electricity for lamps and motors in Bremerton. The company proposes to construct an electric railway between Bremerton and Charleston, 4 miles distant, which, it is understood, will ultimately be extended to Port Orchard, Union City, Shelton, and into the Gray's Harbor district.

ECHO, WASH.—The Snow Creek Water Company, recently incorporated, is reported to have applied to the Council for a franchise to supply electricity in Echo.

LEAVENWORTH, WASH.—The Tumwater Light & Water Company is reported to have been granted an electric-light franchise in Leavenworth for a term of forty-three years.

LYLE, WASH.—The Pacific Power & Light Company is reported to have purchased a power plant, located 25 miles east of the town. It is understood that the company will enlarge the plant.

BARABOO, WIS.—A special committee has been appointed to look into the matter of installing a municipal electric-light plant, for which bonds to the amount of $45,000 were recently voted. J. S. Worthman is city clerk.

MERRILL, WIS.—The Merrill Railway & Lighting Company expects to purchase thirty lamp standards, each carrying a single lamp. E. S. King is secretary and manager.

OCONOMOWOC, WIS.—The contract for the construction of the new concrete dam and power plant to be erected on the Okauchee Lake property of Henry Schoelkopf, of Milwaukee, Wis., has been awarded to J. Nelson & Company. The cost of the dam is estimated at $25,000.

RHINELANDER, WIS.—The Wisconsin Valley Improvement Company is reported to be contemplating the construction of a large dam at Bardley, on the Tomahawk River, for power and mill purposes.

SUPERIOR, WIS.—Preparations are being made for extensive improvements and extensions to the system of the Superior Light & Power Company, which will involve an expenditure of about $100,000 and include the installation of new transformers, remodeling and enlarging the pumping station and installation of a new pump having a capacity of 5,000,000 gal. daily, and the construction of two new reservoirs near the pumping station. Thomas B. Scott is president of the company.

WAUKESHA, WIS.—The Waukesha Gas & Electric Company is installing a 650-kva turbine in its new station, and is also making extensive changes in its switching equipment. H. M. Buck is manager.

WAUSAU, WIS.—The Wausau Street Railway Company, it is reported, is planning to make improvements to its system involving an expenditure of about $50,000. The extension of the Third Avenue and Sixth Street lines is included among the proposed improvements.

WEST BEND, WIS.—Preparations are being made for the construction of building for county home, bids for which will be received until May 29. The plans include the installation of a power plant. The cost of the work is estimated at about $41,000. J. E. Hennen, of Fond du Lac, Wis., is architect and Anton Thielmann is county clerk.

CALGARY, ALTA., CAN.—It is understood that a recommendation will be made to the City Council to the effect that those who wish ornamental street lamps in front of their property will be required to pay half of the cost of maintenance.

WINNIPEG, MAN., CAN.—Bids will be received by the Chairman of Board of Control, Winnipeg, Man., until July 3 for furnishing material and installing police patrol telegraph system. F. A. Cambridge is city electrician and M. Peterson city secretary.

BERLIN, ONT., CAN.—A by-law to appropriate $20,000 for improvements to the municipal electric-light plant will be submitted to the ratepayers on May 31, also a by-law appropriating $7,900 for a street railway.

GUELPH, ONT., CAN.—The People's Railway Company is reported to have awarded contracts for the construction of its proposed electric railway from Guelph to London, via Berlin and Woodstock, to the Acme Construction Company, of Toronto, Ont. Several of the municipalities through which the railway will pass have subscribed to preferred stock of the company to the amount of $295,000, and individuals have taken $150,000. W. A. Bugg is managing director of the company.

HAMILTON, ONT., CAN.—Arrangements are being made by the Dominion Power & Transmission Company for the construction of an electric railway from Hamilton to Galt. It is proposed to use the track of the Brantford & Hamilton Street Railway Company to Brantford, and from there to cut across the country to Galt. The company also intends, if the railway which John Patterson is endeavoring to build is constructed in a direct line from Hamilton to Waterloo and Guelph, to build a line to connect with it, which will give Hamilton direct service connection with Galt, Berlin and Guelph. The Dominion Power & Transmission Company is enlarging its generating plant at Power Glen, increasing the output from 45,000 hp to about 60,000 hp, so as to be able to supply electricity to operate the above interurban railway and for other extensions to its present railway system. William C. Hawkins is general manager.

PENETANGUISHENE, ONT., CAN.—The by-law appropriating $27,000 for installing the municipal hydroelectric power system was carried. Of this amount $10,500 will be utilized for extensions and improvements.

MONTREAL, QUE., CAN.—The Board of Control is reported to be considering the question of calling bids for enlarging the present aqueduct, which is nearly completed. It is proposed to double the capacity of the aqueduct so as to provide sufficient water to generate electricity to light the entire city of Montreal. Specifications are now being prepared for the proposed work.

PRINCE ALBERT, SASK., CAN.—Tenders will be received by the City Commissioners, Prince Albert, Sask., until May 31, for extensions to water and sewerage systems, including the construction of concrete sewage pumping station No. 2, and supplying and installing two electrically driven centrifugal sewage pumps and motors. Plans and specifications for Sections A and B may be seen at the office of F. A. Creighton, city engineer, Prince Albert, Sask., and Section C will be forwarded on application to the city engineer. Andrew Holmes is Mayor.

PRINCE ALBERT, SASK., CAN.—Sealed tenders will be received by the city of Prince Albert, Sask., Can., until June 26 for equipment for the La Colle Falls power station, as follows: Three 1300-hp vertical turbines, two 250-hp vertical turbines and five governors for above; three 937½-kva generators, two 150-kw exciters, two 1850-kva transformers, switching apparatus, lightning arresters and voltage regulator. Plans and specifications will be on file after June 1 at the City Hall, Prince Albert, or at the offices of C. H. & P. H. Mitchell, engineers, Traders' Bank Building, Toronto, Ont., Can. Andrew Holmes is Mayor.

ROULEAU, SASK., CAN.—Bids will be received by W. H. Stewart, secretary and treasurer, until May 29, for construction of power house in Rouleau, in connection with water-works system. J. Darlington Whitmore, MacKenzie & Brown Block, Regina, Sask.

SOUTH QU'APPELE, SASK., CAN.—It is reported that the local electric light company is contemplating erecting a new power house and using gasoline for motive power. L. G. Bell is secretary and treasurer of Board of Trade.

New Industrial Companies.

THE ELECTRIC HEATING COMPANY, of Boston, Mass., has been incorporated with a capital stock of $25,000 by Henry J. Cushing, Nelson E. Mann and Harold A. Mann.

THE ELECTRIC WELDING COMANY, of Pittsburgh, Pa., has been granted a charter, with a capital stock of $5,000. The directors are: R. A. Cummings, Stanton Avenue, Pittsburgh, Pa., treasurer; E. Cummings, and J. E. MacCloskey, Jr., both of Pittsburgh, Pa.

THE LANGDON & HUGHES ELECTRIC COMANY, of Utica, N. Y., has been incorporated with a capital stock of $5,000 by Walter T. Langdon, Dennis A. Hughes and George S. Langdon. The company proposes to conduct an electrical contracting business.

THE REBUILT TELEPHONE EQUIPMENT COMPANY, of Chicago Ill., has been incorporated with a capital stock of $2,500 by Frank T. Sollivan, Phillip L. Sollivan, William J. Maher and Edward C. Stoeffhass.

New Incorporations.

SAN FRANCISCO, CAL.—A company has been organized under the title of The St. George Corporation to conduct a light and power business in Del Norte County, and also to furnish power of all kinds, to operate ferries and to run tugboats and other business. The company is captalized at $1,000,000, and the incorporators are: George M. Warren, of Warrenton, Ore.; Francis E. Rowell, of Hillsboro, Ore.; H. S. Wooley, Charles M. Lanning and Charles R. Wilson, of Wooleyport, Del Norte County, Cal., and Taggart Aston, of San Francisco, Cal.

DOVER, DEL.—Articles of incorporation have been filed for the Frederick Water, Light & Power Company with a capital stock of $25,000.

The incorporators are: H. A. Elwell, H. T. Downing and J. S. Hoy, of Philadelphia, Pa.

ALBION, ILL.—The Albion Electric Light & Gas Company has been incorporated, with a capital stock of $20,000, by W. A. Achock, H. M. Knipe and W. H. Broaran. The company proposes to operate an electric light and gas plant.

CHICAGO, ILL.—The Chicago, Waukegan & Woodstock Traction Company has filed articles of incorporation, with a capital stock of $50,000. The company proposes to construct an electric railway from Waukegan, in Lake County, to Woodstock, in McHenry County. The directors are: Charles A. Spenny, of Columbus, Ohio; Irving D. Stevens, W. P. McCracken, Peter B. Olsen and H. S. Hedberg, all of Chicago, Ill.

BOONE, IA.—The Central Iowa Light & Power Company has filed articles of incorporation with a capital stock of $5,000 for the purpose of supplying electricity for lamps and motors.

HUMBOLDT, IA.—Articles of incorporation have been filed for the Northern Iowa Power Company by N. T. Guernsey, F. A. Brown, A. G. Ripley, F. W. Lehmann, Jr., and C. F. Maxwell, all of Des Moines, Ia. The company is capitalized at $1,000,000 and proposes to operate a light, heat and power plant.

MAXWELL, IA.—The Maxwell Light & Heat Company has been incorporated with a capital stock of $5,000 by J. G. Wells, Charles Ollinger, N. W. Dickson, H. J. Garlock and A. J. Fawcett.

BOSTON, MASS.—The Hixton Electric Company has been incorporated with a capital stock of $30,000 by Alfred J. Hixon, Clifford J. Titus and Nathan L. Bennock.

EXCELSIOR, MO.—Articles of incorporation have been filed for the Excelsior Water, Gas & Electric Company with a capital stock of $500,000 by H. T. Henderson, S. W. Henderson and W. H. Pratt.

ST. LOUIS, MO.—The Zwalle Light, Ice & Power Company has been chartered with a capital stock of $25,000 by William D. Stock, John W. Stock and James A. Steele.

CANONSBURG, PA.—The Union Township Electric Company has been granted a charter with a capital stock of $5,000. The directors are: J. S. Tannehill, of Canonsburg, Pa.; Earl Beach, N. S., Pittsburgh, Pa., and C. R. Turton, of Aspinwall, Pa.

ERIE, PA.—The Erie Lighting Company has been incorporated with a capital stock of $50,000. The directors are: E. D. Carter, of Erie, Pa., treasurer; Louis Streuber, Paul Mueller, M. J. Fogarty and John Maahs, all of Erie, Pa.

MADISON, WIS.—The Peninsula Power Company has been incorporated by D. H. Otis and C. A. W. Tresler, members of the faculty of the University of Wisconsin, and Henry J. Hunt. The company is capitalized at $750,000 and proposes to utilize one of the water powers of the northern peninsula of Michigan and build an electric plant.

Personal.

PROF. D. C. JACKSON has been appointed temporary chairman of the committee on public utilities of the Boston Chamber of Commerce to serve during the absence of Chairman Henry Howard.

MR. WILLIAM McCARROLL, Public Service Commissioner, First District, New York, was married May 16 to Mrs. Grace J. Johnston, widow of the late Mr. W. J. Johnston, formerly publisher of the *Electrical World*.

PROF. HENRY S. CARHART, who retired some time ago from his chair at the University of Michigan, has been a guest for some months at the Bureau of Standards, in Washington, where he has been carrying on some special investigations.

MR. A. H. ARMSTRONG, who was recently elected mayor of Lincoln, Neb., by the largest majority ever received for that office, has severed his connection as head of the Lincoln Gas & Electric Company, to be succeeded by Mr. Frank W. Frueauff.

MR. S. W. GREENLAND, for four years secretary-treasurer and general manager of the Columbus (Miss.) Railway, Light & Power Company, has tendered his resignation to become purchasing agent for the Ft. Wayne & Northern Indiana Traction Company.

MR. H. M. BYLLESBY, of Chicago, delivered recently an able and carefully thought-out address on "Securities of Water-Power Companies as Investments" before the Wharton School of Finance and Commerce of the University of Pennsylvania. The address has been published in pamphlet form.

MR. O. B. COLDWELL, general superintendent of the light and power department of the Portland (Ore.) Railway, Light & Power Company, is making a tour of the Middle and Eastern States for the purpose of inspecting the notable hydroelectric developments in this part of the country. Mr. Coldwell, who was instrumental in the promotion of the Portland Section of the American Institute of Electrical Engineers and served as its first chairman, is a graduate of Stanford University and Cornell University.

HON. ADAM BECK, chairman of the Hydroelectric Commission of Ontario, sailed from Quebec on May 20 for Europe, where he will be joined by Chief Engineer P. W. Sothman and W. B. Roadhouse, private secretary of the Minister of Agriculture. In company with Mr. Beck, these two will continue their investigation of the application of electric power for farm work and rural use generally. During the absence of Mr. Beck Hon. J. S. Hendrie and Mr. W. K. McNaught, M. P. P., the other two members of the commission, will transact the business of the commission.

MR. WILLIAM H. COUGHLIN, for twenty-seven years superintendent of the Worcester (Mass.) Electric Light Company, has sent in his resignation to the board of directors. Mr. Coughlin is one of the best known central station managers of the East, and has been closely identified with the development of the Worcester plants and system since 1883, when he came to Worcester from Groton to accept the superintendency of the company. Under his administration the company has grown from the standards of a small belted station with overhead distribution to those of a modern turbine plant with an unusually large installation of underground service, and from an organization of insignificant commercial position to one of the most substantial and prosperous central stations of New England. It is stated that he will continue to maintain consulting relations with the company for an indefinite period.

DR. SVANTE ARRHENIUS, of Stockholm, Sweden, lectured at the City College of New York on the afternoon of May 17. The subject was "The Passage of Micro-Organisms Through Inter-Stellar Space; a Theory Bearing on the Origin of Life on a Planet." This subject was chosen instead of "Electrolytic Dissociation," as previously stated in these columns. In the evening of the same day Dr. Arrhenius was a guest of honor at a dinner given by the Chemists' Club. On this occasion he was elected an honorary member of the club and spoke on the subject of "Electrolytic Dissociation." He referred to the time when his theories were first published, telling how he traveled around the world to introduce the theories and how they were received by scientists such as Oswald, Van't Hoff, Planck and Nernst. On May 18 he delivered a lecture at the Columbia University, the subject treated being "Adsorption." On the following days Dr. Arrhenius was entertained by his countrymen and on May 22 he returned to Sweden.

MR. FRED H. SMITH has been appointed general manager of the Worcester (Mass.) Electric Light Company, succeeding Mr. W. H. Coughlin. Mr. Smith is a native of Bangor, Me., and devoted the first years of his electrical service to the work of trouble expert for the Thomson-Houston interests at Lynn, Mass., later becoming attached to the Boston office of the General Electric Company as assistant engineer with Mr. A. R. Bush. In 1896 he joined the staff of the Worcester Company as its electrical engineer, being placed in immediate charge of the distribution system and supervising a large part of the underground conduit construction following his advent. About a year ago he was appointed assistant superintendent and has since borne increasing responsibilities in connection with the construction and established service of the company's new Webster Street turbine station, the development of an active commercial policy, and in particular, the extension of the power load and cultivation of closer personal relations between the company and its patrons.

Obituary.

MR. ROBERT D. FERGUSON, whose death was noted in this column last week, was buried in Boston a few days ago. Mr. Ferguson lost his life in a boating accident on the Ohio River at Evansville, Ind., and it was feared that his body would not be recovered. The remains were found after several days, however, and were taken to Boston for burial.

MR. HENRY HUTCHINS SYKES, general manager of the Southern New England Telephone Company, died in New Haven, Conn., on May 18. He was born in Suffield, Conn., in 1867. He was graduated from the Yale Scientific School in 1889 and from the Massachusetts Institute of Technology in 1891. Immediately afterward he became connected with the American Telephone and Telegraph Company, remaining with that company until 1895. In that year he was appointed chief engineer of the Bell Telephone Company of Missouri, and went to live in St. Louis. In 1902 he went to New Haven as general superintendent of the Southern New England Company, and in January, 1907, was made general manager. Mr. Sykes was an associate of the American Institute of Electrical Engineers, a member of the Quinnipiack, Union League and Graduate clubs of New Haven and of the Yale Club of New York.

Trade Publications.

CURVE-DRAWING AMMETERS AND VOLTMETERS.—The General Electric Company has issued Bulletin No. 4820, which supersedes its previous bulletin on recording ammeters and voltmeters.

BALL-BEARING GREASE.—The Hess-Bright Manufacturing Company, 2020 Fairmount Avenue, Philadelphia, has issued a descriptive sheet, with price list, of Hess-Bright ball-bearing grease, which has been compounded specially to suit the lubricating conditions of ball bearings.

FOUNDRY MACHINERY.—The Mumford Molding Machine Company, of Plainfield, N. J., has just issued a loose-leaf sheet catalogue illustrating its line of molding machines for foundry work, and including jolt ramming machines, split-pattern machines, power squeezers and pneumatic vibrators.

SWITCHBOARD INSTRUMENTS.—The Weston Electrical Instrument Company, Newark, N. J., has issued an illustrated folder devoted

to its complete line of switchboard indicating instruments, including wattmeters, synchroscopes, power-factor meters, frequency meters, voltmeters and ammeters.

CRANES AND MACHINE TOOLS.—The Q. M. S. Company, Plainfield, N. J., has just issued loose-leaf catalogs illustrating its line of metal sawing machines, hand-power traveling cranes, jib cranes, I-beam trolleys, pneumatic hoists, power hack saws, car-wheel grinding machines, Stanwood car steps and pneumatic pit jacks.

TELEPHONE SWITCHBOARDS.—In its Bulletin No. 1003 the Western Electric Company describes magneto, convertible, non-multiple switchboards with self-restoring line signals. These switchboards are so designed that they can be used originally for magneto service, and can be converted at will for central-battery operation.

WIRING MATERIAL.—The H. T. Paiste Company, Philadelphia, Pa., has issued a condensed catalog and price list of standardized wiring material. In this catalog, which is designated as No. 18, careful distinction is made between fittings which have and fittings which have not been approved by the National Board of Fire Underwriters.

POLE-LINE SPECIALTIES.—W. N. Matthews & Brother, St. Louis, Mo., have issued the third edition of their telephone-line construction book, dealing with the erection of poles from the boring of the hole in the ground to the placing of the insulators on the cross-arm pins. The present edition contains 240 pages, covering an unusually large amount of usable data.

MOTOR-DRIVEN FIRE PUMPS.—Bulletin No. 1622 of the Allis-Chalmers Company, Milwaukee, Wis., contains a well-prepared article descriptive of the high-pressure fire-service system in use in lower New York. The descriptive matter covers the complete equipment of two fire stations, each of which contains five five-stage centrifugal pumps driven by induction motors.

CHARGING ELECTRIC VEHICLES.—The General Electric Company has issued an attractive pamphlet entitled "Charging the Electric at Home." This pamphlet describes briefly the mercury-arc rectifier as used for charging the batteries for electric runabouts. The publication should prove of interest to owners of such vehicles, since it describes a method of overcoming the difficulties which usually attend the charging of the batteries.

AMMONIA CONDENSER.—Catalog No. 401 of the Griscom-Spencer Company, 90 West Street, New York, describes an evaporative ammonia condenser which is said to require only 4 per cent of the amount of water generally used in pipe condensers. The condenser illustrated is arranged for motor operation, and is designed with particular reference for use in refrigerating and ice-making plants where condensing water is not plentiful.

WIRE SPECIALTIES.—The Fancleve Specialty Company, Jamaica Plain Station, Boston, Mass., has issued a well-illustrated catalog of twenty-six pages devoted to fittings for use with interior wiring construction. Among the new features are fittings for use with metal moldings and others for use with flexible conduits and armored cables, which employ the clamp type of connector for fastening and grounding rather than the set screw type.

DIRECT-CURRENT MOTORS.—The importance of direct-current motors is now well established in practically every industry. The selection of the right kind of motor has consequently become a matter of very great importance. Bulletin No. 132 published by the Crocker-Wheeler Company, of Ampere, N. J., contains information regarding the design of one line of these machines that should be of interest to all users of motor-driven machinery.

CRANE AND HOIST MOTORS.—Bulletin No. 129 printed on the subject of crane motors by the Crocker-Wheeler Company at Ampere, N. J., has much in it that should be of interest to anyone who is in any way responsible for the installation or operation of electric cranes. This pamphlet is handsomely illustrated with halftone engravings which show many interesting applications of electric motors to cranes and hoists under widely different conditions.

ELECTRIC FANS.—The General Electric Company has issued a very attractive bulletin which illustrates and describes its electric fans for the coming season. These fans are made for either alternating current or direct current, and in various styles and sizes to meet various conditions. The publication lists fans suitable for the home, office and restaurant, and fans which can be placed on desk or table or fastened to the wall or ceiling. The bulletin, which is No. 4806, lists also various small motors.

RAILWAY MOTORS.—Bulletin No. 4822 of the General Electric Company, illustrates and describes its GE-98 railway motor which was designed to meet the demands of heavy city and suburban service, and is suitable for either two or four-motor equipments. The motor is rated at 50 hp. The publication contains dimension diagrams, characteristic curves, a table of schedule speeds and a form for a prospective customer to fill out and forward to the company when desiring further information on this motor.

LUBRICATOR PUMP.—The Phenix lubricator oil pump, square and round types, is the subject of an attractive 16-page catalog recently issued by the Richardson-Phenix Company, of Milwaukee. Besides pointing out the special applications and advantages of the Phenix force feed lubricator for cylinder lubrication, data concerning different types of power plants are given showing that the rubbing surface and also the power consumption of auxiliaries bear a rather high ratio to the total power ouput of the plant. The pamphlet then points out that it is foolish to spend a lot of money in proper lubrication of main units without devoting some attention to the auxiliaries.

BUSINESS NOTES.

MR. F. C. FINKLE has moved his consulting engineering offices from 628 South Spring Street, to the I. W. Hellman Building, Los Angeles, Cal.

J. R. DEANE & COMPANY, of Chicago, announce their removal from the Isabella Building to 332 South Michigan Avenue (McCormick Building). The firm has the agency for Peerless motors and dynamo sand Colonial fans.

THE GENERAL ELECTRIC COMPANY has lately shipped to the Southern Power Company a 12-000-amp, triple-pole, 650-volt alternating current circuit-breaker, to be used in controlling the current from the 600-volt side of an 11,000/600-volt, 60/40-cycle, 6600-kw frequency-changer set. This is stated to be the largest capacity of alternating-current circuit-breaker that has ever been manufactured.

PARTRICK, CARTER & WILKINS COMPANY, Philadelphia, suffered from a fire in its factory building on the night of May 16, which caused considerable damage and a temporary shutdown. The loss is being adjusted and arrangements made for an early resumption of work. The firm asks its friends in the trade to be patient in case of any delays in filling orders, as it expects soon to have the factory in operation.

MR. H. J. BREWER has severed his connection with the Connecticut Dynamo & Motor Company, of which he has been president for several years, and has become associated with the Ideal Electric & Manufacturing Company, of Mansfield, Ohio, as manager of its New York office. Mr. Brewer has been in the electrical manufacturing business for the past fifteen years, and has an unusually large circle of acquaintances throughout the United States.

THE J. FAESSLER MANUFACTURING COMPANY, Moberly, Mo., maker of Boss and Universal flue expanders, flue cutters and other boiler tools, has reorganized its sales department and placed Mr. Chas. F. Palmer in charge as sales manager, with office at 810 Olive Street, St. Louis. Mr. Palmer is well qualified for this position through previous experience in selling Faessler tools and as representative of the Frank E. Palmer Supply Company, of St. Louis.

THE NORTHWEST ELECTRICAL EQUIPMENT COMPANY has opened offices at 530 Lumber Exchange, Portland, Ore., as manufacturers' agent and is preparing to take care of the trade for the American Electric Fuse Company, Hygrade Incandescent Lamp Company and several other specialties, such as overhead material for electric rail ways and steel transmission towers, besides electric hammers and tools. Mr. W. H. Banes, formerly of the J. C. English Company, is president and general manager of the new concern.

THE FRED LEE COMPANY, 40 East Twentieth Street, New York, has taken over the assets of the T. Fred Lee Company, which had been doing business for several years at 514 Atlantic Avenue, Boston, and 302 Asylum Street, Hartford, Conn., as Eastern distributor for the Shelby Electric Company, of Shelby, Ohio, incandescent lamp manufacturer. The Fred Lee Company, however, is distributor of electrical illuminating appliances; that is, Eastern incandescent lamps, reflectors and fixtures. The firm will not repair electrical machinery, as erroneously stated in these columns, but do business as manufacturer and jobber of electrical illuminating appliances.

THE CHICAGO ARMATURE & MOTOR COMPANY, of 552 West Harrison Street, Chicago, is a new organization. Mr. Leonard C. Jones is president and Mr. Gustav Jost superintendent. The concern will do repairing of motors and generators, making a specialty of alternating-current work. Mr. Jones was formerly connected with the Westinghouse works at Pittsburgh, being foreman of the transformer department when he left. Later he was employed for four years in the Chicago repair shop of the General Electric Company. Mr. Jost has been foreman in the electrical repair department of the Northwestern Electric Company, Chicago. He has also been connected with the General Electric repair shops, Chicago.

HODENPYL, HARDY & COMPANY.—Messrs. Anton G. Hodenpyl, George E. Hardy and John C. Weadcock, of the firm of Hodenpyl, Hardy & Company, the formation of which was noted in our issue for May 4, have been associated with the management and financing of public service and other corporations for a number of years. Mr. Bernard C. Cobb, who is associated with the new firm, has been closely identified with the management of gas, electric and street railway companies in Michigan, Illinois and Wisconsin, and particularly with the gas companies in Grand Rapids, Detroit, Saginaw and Bay City, Mich. William H. Barthold, who is also associated with Messrs. Hodenpyl, Hardy & Company, has for many years served the companies which will be managed by the new firm as consulting engineer. Messrs. William M. Eaton and E. J. Bechtel are connected with the new firm in executive and engineering capacities. Mr. Eaton has occupied important administrative positions in connection with gas and electric properties at Jackson and Grand Rapids, Mich., and Rochester, N. Y., and for some time has been giving his attention to the development of water powers and to the electric-lighting and motor-service interests of the firm in Michigan. Mr. Bechtel will serve as consulting engineer, and will also discharge executive as well as engineering duties in connection with the various properties controlled by the firm.

Weekly Record of Electrical Patents

UNITED STATES PATENTS ISSUED MAY 16, 1911.
[Conducted by W. F. Bissing, Patent Law, 2 Rector St., N. Y. City.]

992,165. TELEPHONE SYSTEM; H. P. Clausen, Chicago, Ill. App. filed March 17, 1902. Bimetallic, central energy system with a pair of supervisory relays controlling a supervisory signal and a line relay shunted by one of the supervisory relays to control the line signal.

992,174. TROLLEY GUIDE; E. De Planque, Philadelphia, Pa. App. filed Sept. 22, 1910. The harp is provided with upward and outward guide fingers to receive and guide the wheel to the wire.

992,201. SYSTEM OF ELECTRIC MOTOR CONTROL; H. D. James, Pittsburgh, Pa. App. filed June 8, 1907. A plurality of independently operated switches for governing the acceleration with alternating motors with means for delaying the closing of the last switch. The system includes a voltage reducing transformer with switches for controlling the transformer circuit.

992,202. SYSTEM OF ELECTRIC MOTOR CONTROL; H. D. James, Pittsburgh, Pa., and E. Lehr, Wilkinsburg, Pa. App. filed Sept. 3, 1907. For starting polyphase induction motors by means of electrically operated switches having a plurality of actuating magnets whose windings carry currents of different phases with automatic means for delaying the introduction of the secondary resistance in the controlled circuit, the switches being initially actuated from a single-phase source and their coils connected in polyphase relation when the switches close.

992,205. TUNNEL AND PLATE-HOLDER SLIDE FOR X-RAY PICTURES; J. R. Kelley, Cincinnati, O. App. filed April 20, 1909. For exchanging plates in a plate holder to locate the object. Details.

992,214. ELECTROPNEUMATIC BRAKE; L. A. Lariviere, Paris, France. App. filed June 13, 1910. Electropneumatic valve doing away with the train pipe. The valve is placed under each carriage and actuated from a rheostat by the engine driver, admitting air from the reservoir to the brake.

992,217. UNIT SWITCH CONTROL SYSTEM FOR ELECTRIC MOTORS; E. Lehr, Wilkinsburg, Pa. App. filed June 8, 1907. A plurality of control switches which close in a certain order with a series relay switch, and intermediate relay switches which alternately delay the action of the successive control switches to permit the series relay switch to act after each control switch is closed.

992,280. POLYPHASE MOTOR; S. Sparrow, St. Louis, Mo. App. filed April 30, 1910. Induction motor with distributed winding. Increase torque at starting. A number of the elements of the winding are permanently short-circuited and the rest may be when desired.

992,281. ELECTRIC FURNACE; E. C. Speiden, Niagara Falls, N. Y. App. filed Jan. 31, 1911. By arranging the electrodes at an angle, the heat developed by the electrode terminals is intercepted and reflected upon the molten bath by the upper portions of the electrodes.

992,289. MULTIPLE VOLTAGE CONTROLLER; E. W. Stull & G. B. Schley, Milwaukee, Wis. App. filed Sept. 30, 1909. The motor armature is changed from one set of mains to the other of different voltage without breaking the circuit by means of a drum controller and by throwing in a variable resistance which is cut out when the change is made from the higher voltage mains to the lower.

992,294. MOTOR STARTER OR ELECTRIC CIRCUIT CONTROLLER; G. G. Thompson, Muskegon, Mich. App. filed Dec. 31, 1910. A pair of resistance elements consisting of columns of disks to which the pressure is applied by an equalizer bar operated by a lever and link connection.

992,300. ELECTROMAGNETIC APPARATUS; M. Walker, Manchester, England. App. filed Dec. 16, 1905. The cores are magnetized by alternating currents in such a way as to obtain constant polarity. A continuous conductor surrounds the core and includes two paths of unequal resistance responsive to alternating current to give the constant field. A pair of brushes are rotated with relation to the conductor.

992,302. ELECTRIC MACHINE FOR THERAPEUTIC PURPOSES; R. H. Wappler, New York, N. Y. App. filed Oct. 11, 1910. An alternating generator supplies a step-up transformer whose secondary is connected to a rectifier which rotates in synchronism with the generator, giving unidirectional current.

992,333. ELECTRIC EXCHANGE SYSTEM; A. T. Brown, Syracuse, N. Y. App. filed May 28, 1895. Automatic exchange system with an automatically operating controlling device for controlling the selecting switch by governing the passage of the current through the conductors to the controlled mechanism.

992,360. TROLLEY POLE CONTROLLING MECHANISM; M. Kearn, Chicago, Ill. App. filed Aug. 23, 1909. Combines in one mechanism the pole spring and the trolley catcher, with means for preventing lateral swaying of the trolley pole. Details in the construction of the mounting for the trolley pole.

992,372. COMMUTATOR; E. Mattman, Milwaukee, Wis. App. filed Aug. 6, 1909. A plurality of bars supported by a spider and a member having slots secured to the spider to prevent dust from reaching the bars.

992,397. INSULATOR; M. E. Anderson, Louisville, Ky. App. filed Aug. 18, 1910. An insulator in two sections, one having grooves. The wire is clamped between the sections without twisting.

992,417. ELECTRIC TOASTER AND GRIDDLE; H. B. Gale, Natick, Mass. App. filed Nov. 16, 1909. For hotel use. Includes a horizontal, electrically-heated table on which the bread is placed with an electrically-heated plate for toasting the top, the plate being hinged and raised by a spring-pressed arm.

992,427. MEANS FOR CONVERTING ELECTRICAL ENERGY INTO MECHANICAL MOVEMENT; W. Jandus, Cleveland, O. App. filed Nov. 24, 1902. An electrically-heated hot wire is used in a measuring instrument. A multiplicity of the wires in series is suspended between and secured to the base member; two clamps and two inner insulators are provided to which the wires are directly secured.

992,462. INSULATOR; W. Weicker, Hermsdorf, Germany. App. filed May 11, 1907. Discharges the drops of water by electrostatic action. A metallic roof is in electrical connection with the wire which forms an electrostatic field.

992,468. SIGN FLASHER; O. D. Ziegler, Chicago, Ill. App. filed Oct. 13, 1910. A rotating shaft which operates a number of double-pole knife switches.

992,477. AUTOMATIC FIRE ALARM; H. Becker, Newport, Ky. App. filed Oct. 21, 1910. Thermostat, including a glass container which holds the mercury. Details.

992,478. ELECTRIC SWITCH AND CUT-OUT DEVICE; R. Birnn, New York, N. Y. App. filed Mar. 24, 1910. For molding strips used in wiring buildings, the switch and the cut-out being specially proportioned and designed to fit into the molding strip.

992,479. ARC LAMP; A. Blondel, Paris, France. App. filed Jan. 15, 1906. Inclosed lamp with conduit for the gases which are returned to the point below the arc. The circulation is produced either by natural draft or by means of a fan driven by a motor.

992,539. TEST SWITCH FOR RECORDING WATTMETERS; H. G. Blokusewski, Weehawken, N. J. App. filed June 25, 1909. Three conducting blocks arranged in a circle, two of them in the work circuit and three similar blocks opposite the first, all in the circuit, and two additional blocks within the circle, with a movable lever cooperating therewith.

992,541. THERMOSTAT; M. J. Briggs, Philadelphia, Pa. App. filed June 8, 1908. Protects the thermostat from moisture and gases by inclosing it in an elongated tube. The expanding member consists of the zinc tube, and the base carries a pivoted lever whose short arm engages the tube, and the long arm acted upon by a spring closes the circuit.

992,542. THERMOSTAT; M. J. Briggs, Philadelphia, Pa. App. filed Oct. 22, 1908. The expansible member consists of an elongated tube inclosing the contacts, one end of the tube being connected to the short arm of a contact-closing lever.

992,548. FIELD-MAGNET STRUCTURE; W. P. Dandliker, West Allis, Wis. App. filed April 19, 1909. A pair of clamping plates with conversion faces engaged by a spreading block to spread the plates and force them into engagement with the coils.

992,570. INSULATOR; H. R. Markel, Columbus, O. App. filed July 1, 1910. A two-part insulating block whose sections are grooved to grasp the wire between them.

992,583. POWER SYSTEM; A. H. Olmsted, Havre, France. App. filed Sept. 26, 1910. The generator is driven by a gas engine and supplies current to an electric motor for driving the vehicle. The control gear can be operated from any point in the train.

992,595. INSULATOR LINE ATTACHING DEVICE; L. W. Ridenour, Gratis, O. App. filed July 23, 1910. A wire split tie to be fastened to an insulator and through which the line wire passes.

992,600. PROCESS OF TREATING ALUMINUM ARTICLES FOR THE FORMATION OF GALVANIC METALLIC COATINGS; C. Rumpler, Schoenberg, near Berlin, Germany. App. filed Oct. 6, 1910. Treats the article in an electrolytic bath, comprising a solution of two or more metallic double cyanids and a sulphite to prevent oxidation.

992,628. ELECTRICAL DISTANCE CONTROL; A. Aichele, Baden, Switzerland. App. filed Sept. 24, 1909. Multiple-unit control system for trains having a sectional transformer, a master controller, a switch or arm and a motor operator for the switch arm.

992,633. BREAK-GLASS FIRE ALARM; C. Auth, New York, N. Y. App. filed June 11, 1910. A window having two positions and controlling contact mechanism with a bolt mounted upon the window and constituting a latch and a lock, including a locking ring engaging the bolt for holding the window in its normal position.

992,682. MEANS FOR OPERATING ELECTRIC MOTORS DRIVING MOTOR TRAINS; W. A. T. Muller, Berlin-Steglitz, Germany. App. filed Mar. 1, 1911. Supplies current from different sources to the armature winding and field winding of each electric motor of the train, so that the motors may be run forward or backward and electrically braked from the driving car without requiring switches on the other cars.

992,698. METHOD FOR THE PRODUCTION OF DENSE COMPACTED SILICON CARBID; F. J. Tone, Niagara Falls, N. Y. App. filed July 28, 1910. Forms similarly shaped pieces from a mixture of silicon carbid and carbon and heats the pieces near a silicon containing material so as to cause it to combine with the carbon.

992,715. ELECTRIC HEATER; C. S. Hawley, Albany, N. Y. App. filed Jan. 23, 1911. A heating resistance with two casing walls separated by air spaces perforated so that the openings in one wall are opposite the solid portions of the other wall.

992,728. ELECTRIC HEATER; J. F. McElroy, Albany, N. Y. App. filed Jan. 23, 1911. The heating resistance with the casing therefor and an internal deflector in line between the openings in the wall and the resistance.

992,735. ACTUATING MECHANISM FOR STATION INDICATORS OR THE LIKE; O. E. Kellum and T. P. Wilson, Los Angeles, Cal. App. filed Jan. 31, 1910. The wheel engages a member near the rail and closes the circuit to the indicator.

992,738. LINEMAN'S PROTECTOR; H. E. Marshall, Detroit, Mich. App. filed June 20, 1910. A split tubular protecting device with rings of hard rubber engaging the split tube, the tubes being placed over the wires at the cross arms.

992,744. LIGHTNING ARRESTER; E. E. F. Creighton, Schenectady, N. Y. App. filed Feb. 7, 1907. The path to ground includes a spark gap and an automatic switch with an electrolytic condenser, a second path to ground therefor and a larger spark gap.